8 Water Quality and Other Expected Benefits

8.1 Project 1 – Cross Valley Canal to Calloway Canal Intertie

North Kern Water Storage District (North Kern) and Cawelo Water District (Cawelo) are proposing to construct a bi-directional water conveyance connection or intertie, identified as the Cross Valley Canal to Calloway Canal Intertie (Project), and these districts are requesting a grant under Proposition 84 to assist with funding. The intertie is intended to serve several purposes and will provide several types of benefits which include the following:

Water Supply (discussed in Attachment 7)

- Avoided Water Supply Purchases (Bring more surplus surface water into the Region);
- Avoided Operations and Maintenance costs;
- Avoided Water Shortage Costs;
- Revenue From Water Sales;

Water Quality and Other

- Reduce Water Treatment Costs;
- Power Cost Savings;
- Ecosystem Improvements; and
- Emergency Back-up, redundant means for conveying SWP water into North Kern and Cawelo;
- Reduced emissions (due to less pumping);
- Increased Labor; and
- Expanded Water Banking Interconnections; provide route for CVP Delta water and SWP water to be delivered to CVP Contractors to complete banking and exchange agreements

Water Quality and Other Benefits Overview

Water quality and other benefits are analyzed below (Attachment 8). Analysis of the water supply costs and benefits in contained in Water supply costs and benefits (Attachment 7). Note that Flood Damage Reduction Benefits are addressed separately in Attachment 9.

8.1.1 Costs

Costs for the Project 1 are shown in Attachment 7; no additional costs for the Project are expected in order to achieve the Benefits listed in Attachment 8.

8.1.2 Water Quality and Other Benefits

The water quality and other benefits associated with the *Cross Valley Canal to Calloway Canal Intertie* can be either quantified or described qualitatively and are summarized in Exhibit 8.1-1. A summary of costs and benefits is provided in Exhibit 8.1-2. For purposes of the Grant application the monetary Water Quality and Other Benefits used in the economic analysis tables are Reduce Water Treatment Costs, and Reduced Power Cost. The total value of the ***Water Quality and Other Expected Benefits*** is $7,822,044.

EXHIBIT 8.1-1
Project 1 Benefit Overview

Type of Benefit	Assessment	Beneficiaries
Water Supply Benefits		
Avoided Water Supply Purchases	Monetized	Local
Avoided Operations and Maintenance costs	Monetized	
Avoided Water Shortage Costs	Monetized	Local
Revenue From Water Sales	Monetized	
Water quality Benefits		
Reduce Water Treatment Costs	Monetized	Local
Other Benefits		
Power Cost Savings	Monetized	Local
Ecosystem Improvements	Qualitative	Local
Emergency Back-up	Qualitative	Local
Reduced emissions	Quantitative	Local and State
Increased labor	Quantitative	Local and State
Expanded Water Banking Interconnections	Qualitative	Local, State and Federal

EXHIBIT 8.1-2
Project 1 Benefit and Cost Summary (Excluding Flood Damage Reduction Costs and Benefits)

Type of Benefit	Present Value	Qualitative Indicator
Capital and O&M Costs	$12,301,954	
Water Supply Benefits – See Attachment 7		
Avoided Water Supply Purchases	$22,293,270	
Avoided Operations and Maintenance costs	$2,582,499	
Avoided Water Shortage Costs	Monetized	++
Revenue From Water Sales	Monetized	++
Water Quality Benefits – In Attachment 8		
Reduce Water Treatment Costs	$1,085,330	
Other Benefits		
Power Cost Savings	$6,736,713	
Ecosystem Improvements	Qualitative	+
Emergency Back-up	Qualitative	++
Reduced emissions	Quantitative	++
Increased labor	Quantitative	+
Expanded Water Banking Interconnections	Qualitative	++
Total Monetary Benefits	**$32,686,324**	
Notes: *+ indicates net benefits are likely to increase* *++ indicates net benefits are likely to increase significantly* *O&M = operations and maintenance*		

8.1.2.1 Reduced Water Treatment Costs

Periodically KCWA ID4 conveys SWP water to North Kern via PS A in exchange for Kern River water to be processed through the Henry C. Garnett Water Purification Plant. Based on a review of past ID4 Water Conditions Reports, ID4 realizes a savings of about $100,000/year in chemical costs each year it can exchange SWP water for Kern River Water. In order to receive delivery of SWP water ID4 requires use of the CVC Extension Pool 8 and PP7. The new intertie will enable conveyance to North Kern without using CVC PP7 and Pool 8 and PS A. This will save power costs and chemical costs for ID4. Historically about 30,000 AF/year is treated by ID4 (Exhibit 1 of Appendix 7.1-4). This results in an estimated unit savings in chemical costs of $3.33/AF. ID4 recently completed enlargement of the treatment plant facilities which will allow more water to be treated as demands increase. A build-out schedule is provided as Exhibit 2 of Appendix 7.1-4. In 2011 expected treatment demand and capability will increase from 30,000 AF/year to about 40,000 AF/year. Using the average demands from the period 2013 to 2034, which is the demand build-out projection for the Urban Bakersfield Area, about 50,000 AF/year will be treated. Based on prior treatment plant demands, ID4 has historically exchanged 14,362 acre-feet on average with North Kern, which is about ½ of the total demand as shown on Exhibit 3 of Appendix 7.1-4. Therefore for analysis purposes, about half the demand, 25,000 AF/year, will be delivered pursuant to the new facilities constructed with the Project. Therefore with the Project about $83,250/year in savings is expected compared to operating costs without the project. The present value of the reduced water treatment costs over the life of the Project is $1,085,330 as shown in Table 16 – Project 1.

8.1.2.2 Power Cost Savings

In 2007 Cawelo Water District conveyed about 11,000 acre-feet annually through PS A in order to make deliveries into the district. Averaging the deliveries over the last ten years about 17,600 acre-feet get conveyed through PS A on an average annual basis. The Project will eliminate the need to operate PS A, eliminate the need for Cawelo to pay wheeling charges for use of the Beardsley Canal owned by North Kern and will reduce use of the CVC PP7 and associated canal extension Pool 8. Once the water is conveyed into the Calloway canal, North Kern can absorb the water and provide an exchange to Cawelo which will eliminate the need to pump the SWP water into Cawelo's system, thereby saving all PP7 and PS A power costs and not incurring new power costs. North Kern has the ability to serve about 8,000 acres off the Calloway canal which can easily absorb over 28,000 acre-feet on an irrigation demand in addition to the 20,000 acre-feet per month of recharge capability. These exchanges will result in several power cost savings discussed below.

Cawelo pays about $8.50/AF in power costs for PS A, and $3.63/AF for the CVC PP7 for a total of $12.13/AF. Based on the average annual flow of PS A, water supplies better managed by avoiding pumping with the Project have been estimated at 17,600 acre-feet on an average annual basis, as shown in Appendix 7.1-3, Exhibit 1. The annual savings associated with that amount of water is about $213,488. The present value of the avoided power saved by Cawelo WD over the life of the project is $2,783,243 as shown in Table 16 – Project 1.

As discussed in Section 8.1.1 above, periodically KCWA ID4 conveys SWP water to North Kern via PS A. This requires use of the CVC Extension Pool 8 and PP7 in addition to PS A. The new intertie will enable conveyance to North Kern without using PS A, CVC PP7 and Pool 8. This will save $12.13/AF in power costs. As discussed in Section 8.1 the average water better managed due to the Project is 25,000 AF/year. Therefore with the project about $303,250/year in savings is expected for ID4. The present value of the avoided power costs saved by ID4 over the life of the project is $3,953,470 as shown in Table 16 – Project 1.

The total power savings expected for the project is $6,736,713.

8.1.2.3 Ecosystem Improvements

The Poso Creek flood corridor provides a valuable east-west wildlife corridor, enabling migration of various species through the cultivated agriculturally productive northern portion of Kern County. The Cross Valley Canal to Calloway Canal Intertie Project will provide a link to enable more frequent conveyance of water to the Poso Creek channel and wildlife areas associated with the Semitropic Wildlife Improvement District and associated duck clubs

The Poso Creek Corridor has been identified by the U.S. Fish and Wildlife Service as a proposed wildlife linkage for the recovery of the endangered species of the San Joaquin Valley, as depicted on the map provided as Appendix 8.1-1 (U.S. Fish and Wildlife Service 1998b, Regional Conservation Lands).

8.1.2.4 Emergency Back-up; redundant means for conveying SWP water into North Kern and Cawelo.

As has been learned over the years, the need to have back-up conveyance systems has proven to be valuable, especially in times of disaster, power outages, critical water supply shortages, or even terrorist threats. The Cross Valley Canal to Calloway Canal Intertie Project will enable continued deliveries to the growers in North Kern and Cawelo if problems were to occur at the Pump Station A or even at North Kern's primary conveyance facility, the Beardsley Canal. While it is difficult to predict the frequency of such occurrences and quantify the benefit over the life of the project, a one month loss of 165 cfs at PS A during the growing season could result in a loss of about 10,000 acre-feet which could cause loss of 14,286 acres of crops, using a demand for water during the peak growing season of 20% of the 3.5 acre-feet/acre for applied water (.7AF/acre). Using the lost production values from Section 7.1.2.3 "Avoided Water Shortage Costs," a one-time event could create as much as $3,400/acre loss or $48,600,000 in lost economic value if the 14,286 acres is damaged by loss of water during the peak irrigation month.

8.1.2.5 Reduced Emissions of Greenhouse Gasses

The 17,600 AF/yr and the 25,000 AF/yr described above that is conveyed through the Project reduces power consumption in proportion to the power consumed at PS A at 68kWh/AF and CVC PP7 at 40kWh/AF for a total of 108kWh/AF. For the full use of the Project 42,600AF/yr will avoid pumping which results in lower power consumption by 4,600,800kWh/yr (4.6 gigawatthours/year). Reduced power consumption will reduce production of greenhouse gasses. Considering that in California 0.88 pounds of carbon emissions results from each kWh of electricity produced (**Estimating Carbon Dioxide Emissions Factors for the California Electric Power Sector, Chris Marnay, Diane Fisher, Scott Murtishaw, Amol Phadke, Lynn Price, Jayant Sathaye, August 2002, Energy Analysis Department, Environmental Energy**) (Appendix 8.1-2), the Project will reduce carbon dioxide emissions by 4,048,704 pounds per year. In total, over the 50-year life of the Project, approximately 202,435,200 pounds of carbon dioxide emissions will be avoided with the Project.

8.1.2.6 Increased Labor

The Howitt et al report was updated in September 2009, ***Measuring the Employment Impact of Water Reductions, Richard Howitt, Josue Medellin-Azuara, Duncan MacEwan, Department of Agriculture and Resource Economics and Center for Watershed Sciences, University of California, Davis, September 28, 2009,*** to adjust for better information on job impacts related to agricultural production value lost. The revised report concludes that as many as 30 jobs are lost per million dollars in lost farm production. Since as much as $5.5 million in economics losses are prevented with the supply generated from the Project, about 165 jobs will not be lost if the project were implemented. These jobs are extremely important due to the high unemployment experienced in the Poso Creek Regions disadvantaged communities.

8.1.2.7 Expanded Water Banking Interconnections; provide route for CVP Delta water and SWP water to be delivered to CVP Contractors to complete banking and exchange agreements

North Kern and Cawelo have the ability to recharge about 40,000 acre-feet per month, on a short term basis and about 26,000 on a long term basis or about 260,000 acre feet per year. Many years that capacity is taken up with their own supplies, however there are times when the facilities may be available for others. The primary programs outlined by the districts and exchange partners result in about 48,300 acre-feet of use during the year, leaving capacity for to store and convey water for others. For example, water from the San Joaquin Settlement which is run down the San Joaquin River to the Delta can be conveyed into these districts and reregulated for the Friant Kern contractors. The Intertie can also have the potential to help manage timing of pumping from the Delta for both the CVP (San Joaquin Settlement returned water) and SWP water. Different starting contract months can allow use this interconnection to manage some of the supplies out of the Delta depending on water availability out of San Luis. Similarly these facilities could be used to help store SWP carryover that has to be quickly released from San Luis Reservoir to keep from spilling. While these programs have not been thoroughly analyzed, qualitatively the benefits of the *Cross Valley Canal to Calloway Canal Intertie* can become a component of statewide programs.

To the extent that water previously banked in North Kern and Cawelo must be delivered into the California Aqueduct to accomplish the necessary return, the proposed Project, in conjunction with future low-lift pumping plants on the Calloway Canal, would provide the means to do so. This Project advances the capability of the Region to provide water banking relationships to interests outside the Region, potentially having state-wide benefits.

The Project also provides a means for delivery of water banked with Semitropic to be delivered to Shafter-Wasco ID, in order to complete banking and exchange agreements among Poso Creek RWMG districts. For instance, with this Project, Kern-Tulare ID could complete banking arrangements that put CVP-Delta water in Semitropic, and then deliver water to Shafter-Wasco ID via the CVC to Calloway to the North and/or South Interconnections with North Kern and Shafter-Wasco (the North and South Interconnections will be completed in early 2011). The Poso Creek RWMG district recently completed a non-structural CEQA document in December, 2010 that will allow the districts to enter into banking and exchange agreements quickly.

8.1.3 Distribution of Benefits and Identification of Beneficiaries

Reduced electricity demand will benefit the Region by reduced demand on the grid and increased energy reliability. The reduction of power use and thus costs will directly benefit water users in the area. The reduction in carbon dioxide emissions will benefit the residents of California. Reduced carbon emissions is a goal of the State of California as reflected in *Assembly Bill 32, Global Warming Solutions Act of 2006*. Reduced water treatment costs will benefit the water purveyors and residents of the greater Bakersfield Metropolitan Area. Labor increases will benefit the regions disadvantaged communities all of which are within the Poso Creek Region. Improved ecosystem connectivity would benefit the residents of County of Kern. Improved water banking interconnectivity will benefit local, regional, and statewide water management programs.

8.1.4 Benefits Timeline

The estimated life of the Project is over the entire period of analysis, which is 50 years beginning in 2011. The Project will begin in 2011, and full potential benefits will accrue in full upon completion in 2013.

8.1.5 Uncertainties

The benefits defined are based on the best available information regarding availability of SWP Article 21 water and historic operations of the water districts involved. Changes impacting operations of the SWP and the ability to pump from the Delta could change the availability of supplies and therefore the water supply benefits estimated. Therefore there is uncertainty regarding the benefits of power reduction and improved air quality. Current benefit descriptions are based on estimates of future exchanges and water supply conditions that have occurred in the past. Climate change and other factors may change the opportunity of exchanges. These uncertainties can result in more water or less water moved through the Project. Adding flexibility to water conveyance systems is the most prudent activity to do in order to be prepared for the uncertain future.

8.1.6 Potential Adverse Effects

The Project will cause temporary disturbances of land surfaces during construction that will be mitigated, and there are no long-term adverse impacts expected as a result of the Project. Any unforeseen temporary impacts will be mitigated.

8.1.7 Summary of Findings

Project benefits will occur from reduced electricity demand, the emissions resulting from the reduction in energy requirements and environmental enhancements. Power savings and water quality savings are likely to cause a benefit to water system operators estimated to be $7,822,044. Because improved air quality and ecosystem improvements are only discussed qualitatively, not all monetized benefits claimed for this Project.

8.1.8 Appendices

Appendix 8.1-1 Regional Conservation Lands

Appendix 8.1-2 Green House Gas Emissions

8.1.9 Table

Table 16 – Project 1 Water Quality and Other Expected Benefits

LBNL-49945

Estimating Carbon Dioxide Emissions Factors for the California Electric Power Sector

Chris Marnay, Diane Fisher, Scott Murtishaw, Amol Phadke
Lynn Price, Jayant Sathaye

August 2002

Energy Analysis Department
Environmental Energy Technologies Division
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EXECUTIVE SUMMARY

The California Climate Action Registry ("Registry") was initially established in 2000 under Senate Bill 1771, and clarifying legislation (Senate Bill 527) was passed in September 2001. The Ernest Orlando Lawrence Berkeley National Laboratory (Berkeley Lab) has been asked to provide technical assistance to the California Energy Commission (CEC) in establishing methods for calculating average and marginal electricity emissions factors, both historic and current, as well as statewide and for sub-regions. This study is exploratory in nature. It illustrates the use of three possible approaches and is not a rigorous estimation of actual emissions factors. While the Registry will ultimately cover emissions of all greenhouse gases (GHGs), presently it is focusing on carbon dioxide (CO_2). Thus, this study only considers CO_2, which is by far the largest GHG emitted in the power sector.[1]

Associating CO_2 emissions with electricity consumption encounters three major complications. First, electricity can be generated from a number of different primary energy sources, many of which are large sources of CO_2 emissions (e.g., coal combustion) while others result in virtually no CO_2 emissions (e.g., hydro). Second, the mix of generation resources used to meet loads may vary at different times of day or in different seasons. Third, electrical energy is transported over long distances by complex transmission and distribution systems, so the generation sources related to electricity usage can be difficult to trace and may occur far from the jurisdiction in which that energy is consumed. In other words, the emissions resulting from electricity consumption vary considerably depending on when and where it is used since this affects the generation sources providing the power.

There is no practical way to identify where or how all the electricity used by a certain customer was generated, but by reviewing public sources of data the total emission burden of a customer's electricity supplier can be found and an *average emissions factor* (AEF) calculated. These are useful for assigning a net emission burden to a facility. In addition, *marginal emissions factors* (MEFs) for estimating the effect of changing levels of usage can be calculated. MEFs are needed because emission rates at the margin are likely to diverge from the average.[2]

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[1] Note that while the gas emission are referred to as CO_2, quantities of emissions are reported in mass of equivalent carbon, where 1 kg CO_2 = 0.27 kg C.

[2] Note that this is not a *life cycle analysis*. These emissions factors are intended to estimate only the emissions that take place within the boundaries of generating stations. Emissions incurred by the construction of electricity generation facilities and delivery infrastructure; by the extraction (including coalbed methane release), processing, and delivery of fuels to the power plant; or by utilities' support services (e.g. office buildings and maintenance operations) are not included. Even so, transmission and distribution losses should be included for purposes of the Registry. As such, it is recommended that Registry participants multiply the emissions factors reported here by 1.085 to correct for an average transmission and distribution loss of approximately 8%.

Objective of the Project

The overall objective of this task is to develop methods for estimating AEFs and MEFs that can provide an estimate of the combined net CO_2 emissions from all generating facilities that provide electricity to California electricity customers. The method covers the historic period from 1990 to the present, with 1990 and 1999 used as test years. The factors derived take into account the location and time of consumption, direct contracts for power which may have certain atypical characteristics (e.g., "green" electricity from renewable resources), resource mixes of electricity providers, import and export of electricity from utility owned and other sources, and electricity from cogeneration.

It is assumed that the factors developed in this way will diverge considerably from simple statewide AEF estimates based on standardized inventory estimates that use conventions inconsistent with the goals of this work. A notable example concerns the treatment of imports, which despite providing a significant share of California's electricity supply picture, are excluded from inventory estimates of emissions, which are based on geographical boundaries of the state.

Approach

The California electricity sector has undergone significant changes since 1990, and this poses daunting challenges for establishing a consistent method for estimating emissions factors over this period. In addition, publicly distributed data series have changed significantly over this decade. California is a particularly difficult state for calculating emissions factors for several reasons: California's fuel mix is among the most diverse in the nation; a large share of California's electricity is supplied by independent power producers, much of which is from combined heat and power (CHP)[3]; several California utilities own shares of generating facilities in other states; California imports much of its electricity in addition to the power from these California owned out-of-state resources; and direct retail access was in effect from 1998 to 2001.

Berkeley Lab developed three methods for calculating California electricity emissions factors. The first uses the Elfin model to simulate plant operations and estimate emissions for 1990. The second is an accounting method that draws primarily from public data sources (PDS). The third, used for the 1999 test year, is a spreadsheet that applies a simplified load duration curve (LDC). Table EX-1 compares these approaches and summarizes what is included in each approach.

[3] Total fuel consumption is reported by combined heat and power units on the Energy Information Administration survey forms, and several methodologies exist for determining how fuel consumption should be split between the heat and electric outputs. The approach used in this study assigned a fixed conversion efficiency of fuel input to useful thermal output and allocated the remaining fuel to electricity production.

Table EX-1. Comparison of Three Methods for Estimating Emissions Factors

Method	Year	Average Emission Factors	Marginal Emissions Factors	Includes Imports	Includes Exports	Includes CA-Owned Out-Of-State Generation	Excludes Specific Purchases[a]
Elfin Model	1990	Yes	Yes	Yes	No	Yes	N/A
Public Data Sources	1999	Yes	No	Yes[b]	No	Yes	Yes
Load Duration Curve	1999	Yes	Yes	Yes[b]	No	Yes	Yes/No[c]

[a] "Specific Purchases" refers to purchases of electricity by retailers for use in green power products. Generation and associated emissions for these products should be separated from the resources providing power for the general pool of grid electricity to avoid double counting.
[b] Imports are net imports. Thus, exports are not treated explicitly but are subtracted from import totals.
[c] The LDC approach could be modified to exclude specific purchases; however, this was not done for this report due to time limitations.

The Elfin model was used to simulate plant operations and estimate emissions for 1990. This model was a widely used forecasting tool for utility power systems during the 1980s and early 1990s, roughly until publication of the last biennial CEC Electricity Report in 1996. Fortunately, old data sets that were compiled and publicly scrutinized during this period are still available in the public domain and can be used to replicate historic conditions. Data sets for six electricity utility service territories were provided by CEC and all were run for 1990. Elfin has its own built-in algorithms for estimating emissions from cogeneration and imports. This model provides a great deal of versatility for determining emissions factors. In addition to providing annual AEFs and MEFs for the state and each power control area (PCA)[4], it also estimates emissions factors on a monthly basis as well as for other subperiods, such as for on- and off-peak hours.

The second approach for deriving AEFs is an accounting method that draws primarily from U.S. Energy Information Administration (EIA) reporting forms, with some supplemental information from the CEC and the Federal Energy Regulatory Commission (FERC). This method was used to estimate emissions and derive AEFs for the 1999 test year.[5] Historical data on power plant generation and fuel consumption were used to determine plant-specific emissions. These were then aggregated into emission totals for each PCA as well as the entire state.

Due to data limitations, several assumptions were made in order to calculate and assign emissions. One critical decision was that electricity was assumed to serve the load of the PCA where it was generated, an assumption that may not be very accurate with the deregulation of generation.[6] The shares of generation from out-of-state plants partially

[4] A power control area is defined as a grid region for which one utility controls the dispatch of electricity. Some smaller utilities are embedded in the power control areas of larger utilities.
[5] The absence of data on non-utility generation and monthly utility loads precluded the use of the PDS approach to calculate emissions factors for 1990.
[6] By late 1999, California's CAISO utilities had divested most of their thermal power plants to independent power producers; therefore, the relatively fixed relationship between customer load and the plant available

owned by California utilities were also assumed to serve these utilities' loads before other imports would be purchased. Another important assumption concerns the estimation of imports, which were calculated as the difference between PCA generation (including the out of state assets) and total loads. Emissions associated with the imported electricity were calculated by multiplying the quantity of imported electricity by the AEF of the region from which the electricity was assumed to originate.

Other important methodological steps were taken to avoid overestimating emissions from certain plants. In order to avoid allocating total emissions from CHP units, emissions were assigned to grid electricity using a method of deducting fuel input for heat based on a standard conversion efficiency of fuel to useful thermal output. Additionally, *specific purchases* of electricity for green power products and the associated emissions were subtracted from the totals of the PCA in which the electricity was generated.[7]

The third methodology, used for the 1999 test year, is a spreadsheet that utilizes a load duration curve (LDC), as many simulation models do (such as Elfin), albeit in a simplified form. The approach uses publicly available data from the National Energy Modeling System (NEMS) input files. The LDC model provides estimates of annual and monthly AEFs and MEFs by an approximation of the complex plant operation algorithms of more sophisticated models. In the LDC method, plants were placed in order of probable dispatch as follows: 1) nuclear plants, 2) non-thermal imports 3) renewables such as wind, geothermal, and biomass, 4) co-generation facilities, and 5) hydro. All remaining resources (thermal, non-cogeneration facilities) were then taken in order of their capacity factors, highest to lowest. The LDC model makes the same assumption as the PDS approach regarding electricity serving the load of the PCA in which it was generated, although some results for the combined load of the California Independent System Operator (CAISO) are also presented. This is equivalent to treating the three CAISO utilities – Pacific Gas & Electric (PG&E), Southern California Electric (SCE), and San Diego Gas & Electric (SDG&E) as one PCA. Specific purchases have not been separated from the generation totals, but the model can be adapted to do so. Cogeneration did not require additional assumptions as the NEMS data files contain plant-specific heat rates for calculating fuel consumption for electricity generation from CHP plants.

Results

The annual results of the three approaches for the entire state and the four major California utilities are shown in Table EX-2. In terms of total electricity-related CO_2 emissions, the three methods produced similar results. The Elfin model methodology shows total CO_2 emissions of 26.1 MtC in 1990. Since the total state electricity load in 1999 was about 10 percent higher than in 1990, the larger total emissions of 29.5 MtC and 29.0 MtC yielded by the LDC and PDS methods, respectively, are to be expected.

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to serve it no longer holds. For lack of precise sales data, a traditional fixed relationship is assumed in this report.

[7] *Specific purchases* are purchases of electricity by marketers or distribution companies for use in green power products, as defined in California Senate Bill 1305.

This ratio holds roughly true for the state and all PCAs but PG&E. The higher PG&E emissions reported by Elfin for 1990 are due largely to the fact that 1990 was a dry year, and gas plants were operated at greater capacity factors to compensate for lower hydro generation. For 1999, the PDS and LDC methods generated remarkably similar estimates for both the entire state and each PCA.

Table EX-2. Comparison of Annual Results from Three Electricity Emissions Factors Calculation Methodologies

	1990 -Elfin			1999 -LDC			1999 - PDS		
	Emissions (MtC)	AEF (kgC/kWh)	MEF (kgC/kWh)	Emissions (MtC)	AEF (kgC/kWh)	MEF (kgC/kWh)	Emissions (MtC)	AEF (kgC/kWh)	MEF (kgC/kWh)
SCE	11.8	0.132	0.165	12.9	0.131	0.215	12.9	0.132	N/A
SDG&E	2.2	0.132	0.201	2.8	0.146	0.181	2.6	0.140	N/A
LADWP	4.7	0.195	0.191	5.2	0.207	0.199	5.0	0.192	N/A
PG&E[a]	7.3	0.070	0.153	7.0	0.063	0.140	7.0	0.064	N/A
State[b]	26.1	0.110		29.5	0.105		29.0	0.108	

[a] *LDC and PDS results for PG&E include Sacramento Municipal Utility District (SMUD)*
[b] *includes irrigation districts and municipal utilities*

A principal finding here is that the level of CO_2 associated with electricity usage varies considerably among the PCAs, although it comes as no surprise that these values are lower for PG&E than for the southern California companies. PG&E has a large share of carbon-free generation, such as hydro, nuclear, and predominantly hydro imports from the Pacific Northwest.

The LDC and Elfin models produced quite divergent MEFs for all the PCAs except LADWP. (MEFs were not calculated using the PDS methodology). The difference in Elfin's 1990 and the LDC-derived 1999 MEFs for SCE is especially striking. The high 1999 MEF using the LDC method occurs because a large share of the gas-fired generation in this PCA is from cogeneration, which is assumed not to respond to changes in the load. Thus, the load-following resources consist largely of imports from the Southwest. The difference between the 1990 and 1999 MEFs is also large for PG&E, which has the greatest share of nuclear and hydro generation, two resources that are generally never curtailed to follow load. With the exception of LADWP, the MEFs are significantly higher than the corresponding AEFs. Since the MEFs of the PCAs other than LADWP range from 25 to over 200 percent greater than the corresponding AEFs, using AEFs to estimate the CO_2 savings from reducing electricity usage would significantly underestimate actual savings.

Table EX-3 disaggregates California electricity generation, CO_2 emissions and average emissions factors in 1999 by their source based on the PDS results. In-state electricity generation accounts for 63% of total California electric use, while 14% is out-of-state production owned by California utilities and the remaining 23% is imported. Coal produces a negligible share of California's in-state electricity, but is by far the predominant source of energy in the Southwest U.S. Thus, imports from California-owned out-of-state coal plants and other utilities in the Southwest significantly increase California's CO_2 emissions and the statewide AEF. The emissions associated with the electricity from California-owned out-of-state plants alone raises the AEF by a third.

Thus, a simple inventory approach that only counts emissions within California's borders underestimates the CO_2 emissions from electricity used by California consumers.

Table EX-3. Total 1999 California Electricity Generation, Electricity-Related CO_2 Emissions, and Average Emissions Disaggregated by Source[a]

	In-State	CA owned Out-of-State[b]	Total In-State + CA owned Out-of-State	SW Imports[c]	NW Imports[d]	Total CA
Generation (TWh)	170.14	37.16	207.30	42.80	19.76	269.86
CO_2 Emissions (MtC)	11.92	7.36	19.28	8.32	1.41	29.01
AEF (kgC/kWh)	0.070	0.198	0.093	0.194	0.071	0.108

[a] Calculated from public data sources as described in Section III of this report. These figures exclude specific purchases.
[b] This refers to the generation shares of out-of-state plants owned by California utilities.
[c] This represents imports from the Southwest, a region that for purposes of this study includes Arizona, Nevada, New Mexico, Utah, and Colorado. The assumed share of imports from the Southwest is high due to the assumption that southern California utilities receive all imports from this region. Precise sales data would permit allocation of a greater share of imports to the Northwest, which would lower the state total emissions. If the shares were the same as those reported in CEC's California Electricity Generation 1983-2000 (roughly 53% from the Northwest) (CEC 2001b), total emissions would be about 5% lower.
[d] The Northwest region is composed of Montana, Wyoming, Idaho, Washington, and Oregon.

The large share of seasonally varying hydro generation in California combined with typically hot late summer weather implies that AEFs may be higher when increased output from thermal generating sources must compensate for diminished hydro output. Conversely, as more thermal generation is used, the share of natural gas is likely to increase relative to coal, pushing down the AEF of thermal generation. Table EX-4 shows the AEFs calculated for May and October, months that usually have relatively high and low hydro generation. PG&E, the most hydro-dependent PCA, has by far the largest variation between the two months. This occurs both because more gas-fired generation is used within the PCA and more electricity is imported from the Northwest. The fall in hydro generation also causes the AEF of the imported power to increase, as more coal-fired electricity is used to replace the decline in hydropower. PG&E, being the largest PCA, is a large enough share of the statewide total load that the seasonal change in its resource mix significantly affects the statewide AEF. The variation in the other PCAs is much less pronounced and due as much to random changes in plant operations as to differences in hydro output. These results suggest that accounting for seasonal changes in resource mix, particularly for entities located in the PG&E service area, is important to accurately estimate emissions throughout the year.

Table EX-4. 1999 Seasonal Changes in AEFs

Utility	May			October			Percent Difference Oct/May, PDS Total
	CA Generation, LDC[a]	CA Generation, PDS[a]	Total w/ Imports, PDS	CA Generation, LDC[a]	CA Generation, PDS[a]	Total w/ Imports, PDS	
PG&E	0.046	0.043	0.046	0.079	0.079	0.083	79%
SCE	0.086	0.083	0.122	0.111	0.105	0.132	8%
SDG&E	0.091	0.096	0.150	0.105	0.089	0.134	-11%
LADWP	0.205	0.194	0.192	0.208	0.184	0.184	-5%
CA[b]	0.082	0.074	0.098	0.113	0.103	0.117	19%

[a] Includes the shares of out-of-state plants owned by CA utilities.
[b] Includes only the PCAs listed in the table.

Summary of Findings

1. A statewide AEF could drastically misestimate an entity's emissions due to the large differences in generating resources among the service areas.

2. Differentiating between marginal and average emissions is essential to accurately estimate the CO_2 savings from reducing electricity use.

3. Seasonal differences in AEFs due to fluctuations in hydro generation should be accounted for at the statewide level, and particularly for the PG&E area.

4. A more careful effort should be undertaken to interpret and apply the Elfin files in a consistent fashion to obtain more accurate results than are derived here. This will require better matching of historic data, better checking and standardizing of emission data, and better modeling of imports, exports, and trades.

5. The LDC approach proved promising and should be explored further. This approach can also be modified to consider variations in emissions by time-of-day, which could be of interest.

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Table 16 -Water Quality and Other Expected Benefits
(All costs should be in 2009 Dollars)

Project 1: CVC to Calloway Canal Intertie

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Year	**Type of Benefit**	**Measure of Benefit (Units)**	**Without Project**	**With Project**	**Change Resulting from Project**	**Unit Value [1]**	**Annual Value [1]**	**Discount Factor [1]**	**Discounted Benefits [1]**
2009				-			$ -	1.000	$ -
2010							$ -	0.943	$ -
2011							$ -	0.890	$ -
2012							$ -	0.840	$ -
2013	Cawelo Pumping Power Costs	Acre-Feet/Yr	17,600	-	17,600	$ 12.13	$ 213,488	0.792	$ 169,082
	ID-4 Pumping Power Costs	Acre-Feet/Yr	25,000	-	25,000	$ 12.13	$ 303,250	0.792	$ 240,174
	ID-4 Treatment Costs	Acre-Feet/Yr	25,000	-	25,000	$ 3.33	$ 83,250	0.792	$ 65,934
2014	Cawelo Pumping	Acre-Feet/Yr	17,600	-	17,600	$ 12.13	$ 213,488	0.747	$ 159,476
	ID-4 Pumping	Acre-Feet/Yr	25,000	-	25,000	$ 12.13	$ 303,250	0.747	$ 226,528
	ID-4 Treatment	Acre-Feet/Yr	25,000	-	25,000	$ 3.33	$ 83,250	0.747	$ 62,188
2015	Cawelo Pumping	Acre-Feet/Yr	17,600	-	17,600	$ 12.13	$ 213,488	0.705	$ 150,509
	ID-4 Pumping	Acre-Feet/Yr	25,000	-	25,000	$ 12.13	$ 303,250	0.705	$ 213,791
	ID-4 Treatment	Acre-Feet/Yr	25,000	-	25,000	$ 3.33	$ 83,250	0.705	$ 58,691
2016	Cawelo Pumping	Acre-Feet/Yr	17,600	-	17,600	$ 12.13	$ 213,488	0.665	$ 141,970
	ID-4 Pumping	Acre-Feet/Yr	25,000	-	25,000	$ 12.13	$ 303,250	0.665	$ 201,661
	ID-4 Treatment	Acre-Feet/Yr	25,000	-	25,000	$ 3.33	$ 83,250	0.665	$ 55,361
2017	Cawelo Pumping	Acre-Feet/Yr	17,600	-	17,600	$ 12.13	$ 213,488	0.627	$ 133,857
	ID-4 Pumping	Acre-Feet/Yr	25,000	-	25,000	$ 12.13	$ 303,250	0.627	$ 190,138
	ID-4 Treatment	Acre-Feet/Yr	25,000	-	25,000	$ 3.33	$ 83,250	0.627	$ 52,198
2018	Cawelo Pumping	Acre-Feet/Yr	17,600	-	17,600	$ 12.13	$ 213,488	0.592	$ 126,385
	ID-4 Pumping	Acre-Feet/Yr	25,000	-	25,000	$ 12.13	$ 303,250	0.592	$ 179,524
	ID-4 Treatment	Acre-Feet/Yr	25,000	-	25,000	$ 3.33	$ 83,250	0.592	$ 49,284
2019	Cawelo Pumping	Acre-Feet/Yr	17,600	-	17,600	$ 12.13	$ 213,488	0.558	$ 119,126
	ID-4 Pumping	Acre-Feet/Yr	25,000	-	25,000	$ 12.13	$ 303,250	0.558	$ 169,214
	ID-4 Treatment	Acre-Feet/Yr	25,000	-	25,000	$ 3.33	$ 83,250	0.558	$ 46,454

Table 16 -Water Quality and Other Expected Benefits
(All costs should be in 2009 Dollars)

Project 1: CVC to Calloway Canal Intertie

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Year	**Type of Benefit**	**Measure of Benefit (Units)**	**Without Project**	**With Project**	**Change Resulting from Project**	**Unit Value [1]**	**Annual Value [1]**	**Discount Factor [1]**	**Discounted Benefits [1]**
2020	Cawelo Pumping	Acre-Feet/Yr	17,600	-	17,600	$ 12.13	$ 213,488	0.527	$ 112,508
	ID-4 Pumping	Acre-Feet/Yr	25,000	-	25,000	$ 12.13	$ 303,250	0.527	$ 159,813
	ID-4 Treatment	Acre-Feet/Yr	25,000	-	25,000	$ 3.33	$ 83,250	0.527	$ 43,873
2021	Cawelo Pumping	Acre-Feet/Yr	17,600	-	17,600	$ 12.13	$ 213,488	0.497	$ 106,104
	ID-4 Pumping	Acre-Feet/Yr	25,000	-	25,000	$ 12.13	$ 303,250	0.497	$ 150,715
	ID-4 Treatment	Acre-Feet/Yr	25,000	-	25,000	$ 3.33	$ 83,250	0.497	$ 41,375
2022	Cawelo Pumping	Acre-Feet/Yr	17,600	-	17,600	$ 12.13	$ 213,488	0.469	$ 100,126
	ID-4 Pumping	Acre-Feet/Yr	25,000	-	25,000	$ 12.13	$ 303,250	0.469	$ 142,224
	ID-4 Treatment	Acre-Feet/Yr	25,000	-	25,000	$ 3.33	$ 83,250	0.469	$ 39,044
2023	Cawelo Pumping	Acre-Feet/Yr	17,600	-	17,600	$ 12.13	$ 213,488	0.442	$ 94,362
	ID-4 Pumping	Acre-Feet/Yr	25,000	-	25,000	$ 12.13	$ 303,250	0.442	$ 134,037
	ID-4 Treatment	Acre-Feet/Yr	25,000	-	25,000	$ 3.33	$ 83,250	0.442	$ 36,797
2024	Cawelo Pumping	Acre-Feet/Yr	17,600	-	17,600	$ 12.13	$ 213,488	0.417	$ 89,024
	ID-4 Pumping	Acre-Feet/Yr	25,000	-	25,000	$ 12.13	$ 303,250	0.417	$ 126,455
	ID-4 Treatment	Acre-Feet/Yr	25,000	-	25,000	$ 3.33	$ 83,250	0.417	$ 34,715
2025	Cawelo Pumping	Acre-Feet/Yr	17,600	-	17,600	$ 12.13	$ 213,488	0.394	$ 84,114
	ID-4 Pumping	Acre-Feet/Yr	25,000	-	25,000	$ 12.13	$ 303,250	0.394	$ 119,481
	ID-4 Treatment	Acre-Feet/Yr	25,000	-	25,000	$ 3.33	$ 83,250	0.394	$ 32,801
2026	Cawelo Pumping	Acre-Feet/Yr	17,600	-	17,600	$ 12.13	$ 213,488	0.371	$ 79,204
	ID-4 Pumping	Acre-Feet/Yr	25,000	-	25,000	$ 12.13	$ 303,250	0.371	$ 112,506
	ID-4 Treatment	Acre-Feet/Yr	25,000	-	25,000	$ 3.33	$ 83,250	0.371	$ 30,886
2027	Cawelo Pumping	Acre-Feet/Yr	17,600	-	17,600	$ 12.13	$ 213,488	0.350	$ 74,721
	ID-4 Pumping	Acre-Feet/Yr	25,000	-	25,000	$ 12.13	$ 303,250	0.350	$ 106,138
	ID-4 Treatment	Acre-Feet/Yr	25,000	-	25,000	$ 3.33	$ 83,250	0.350	$ 29,138
2028	Cawelo Pumping	Acre-Feet/Yr	17,600	-	17,600	$ 12.13	$ 213,488	0.331	$ 70,665
	ID-4 Pumping	Acre-Feet/Yr	25,000	-	25,000	$ 12.13	$ 303,250	0.331	$ 100,376
	ID-4 Treatment	Acre-Feet/Yr	25,000	-	25,000	$ 3.33	$ 83,250	0.331	$ 27,556
2029	Cawelo Pumping	Acre-Feet/Yr	17,600	-	17,600	$ 12.13	$ 213,488	0.312	$ 66,608
	ID-4 Pumping	Acre-Feet/Yr	25,000	-	25,000	$ 12.13	$ 303,250	0.312	$ 94,614
	ID-4 Treatment	Acre-Feet/Yr	25,000	-	25,000	$ 3.33	$ 83,250	0.312	$ 25,974

Table 16 -Water Quality and Other Expected Benefits
(All costs should be in 2009 Dollars)

Project 1: CVC to Calloway Canal Intertie

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Year	**Type of Benefit**	**Measure of Benefit (Units)**	**Without Project**	**With Project**	**Change Resulting from Project**	**Unit Value [1]**	**Annual Value [1]**	**Discount Factor [1]**	**Discounted Benefits [1]**
2030	Cawelo Pumping	Acre-Feet/Yr	17,600	-	17,600	$ 12.13	$ 213,488	0.294	$ 62,765
	ID-4 Pumping	Acre-Feet/Yr	25,000	-	25,000	$ 12.13	$ 303,250	0.294	$ 89,156
	ID-4 Treatment	Acre-Feet/Yr	25,000	-	25,000	$ 3.33	$ 83,250	0.294	$ 24,476
2031	Cawelo Pumping	Acre-Feet/Yr	17,600	-	17,600	$ 12.13	$ 213,488	0.278	$ 59,350
	ID-4 Pumping	Acre-Feet/Yr	25,000	-	25,000	$ 12.13	$ 303,250	0.278	$ 84,304
	ID-4 Treatment	Acre-Feet/Yr	25,000	-	25,000	$ 3.33	$ 83,250	0.278	$ 23,144
2032	Cawelo Pumping	Acre-Feet/Yr	17,600	-	17,600	$ 12.13	$ 213,488	0.262	$ 55,934
	ID-4 Pumping	Acre-Feet/Yr	25,000	-	25,000	$ 12.13	$ 303,250	0.262	$ 79,452
	ID-4 Treatment	Acre-Feet/Yr	25,000	-	25,000	$ 3.33	$ 83,250	0.262	$ 21,812
2033	Cawelo Pumping	Acre-Feet/Yr	17,600	-	17,600	$ 12.13	$ 213,488	0.247	$ 52,732
	ID-4 Pumping	Acre-Feet/Yr	25,000	-	25,000	$ 12.13	$ 303,250	0.247	$ 74,903
	ID-4 Treatment	Acre-Feet/Yr	25,000	-	25,000	$ 3.33	$ 83,250	0.247	$ 20,563
2034	Cawelo Pumping	Acre-Feet/Yr	17,600	-	17,600	$ 12.13	$ 213,488	0.233	$ 49,743
	ID-4 Pumping	Acre-Feet/Yr	25,000	-	25,000	$ 12.13	$ 303,250	0.233	$ 70,657
	ID-4 Treatment	Acre-Feet/Yr	25,000	-	25,000	$ 3.33	$ 83,250	0.233	$ 19,397
2035	Cawelo Pumping	Acre-Feet/Yr	17,600	-	17,600	$ 12.13	$ 213,488	0.220	$ 46,967
	ID-4 Pumping	Acre-Feet/Yr	25,000	-	25,000	$ 12.13	$ 303,250	0.220	$ 66,715
	ID-4 Treatment	Acre-Feet/Yr	25,000	-	25,000	$ 3.33	$ 83,250	0.220	$ 18,315
2036	Cawelo Pumping	Acre-Feet/Yr	17,600	-	17,600	$ 12.13	$ 213,488	0.207	$ 44,192
	ID-4 Pumping	Acre-Feet/Yr	25,000	-	25,000	$ 12.13	$ 303,250	0.207	$ 62,773
	ID-4 Treatment	Acre-Feet/Yr	25,000	-	25,000	$ 3.33	$ 83,250	0.207	$ 17,233
2037	Cawelo Pumping	Acre-Feet/Yr	17,600	-	17,600	$ 12.13	$ 213,488	0.196	$ 41,844
	ID-4 Pumping	Acre-Feet/Yr	25,000	-	25,000	$ 12.13	$ 303,250	0.196	$ 59,437
	ID-4 Treatment	Acre-Feet/Yr	25,000	-	25,000	$ 3.33	$ 83,250	0.196	$ 16,317
2038	Cawelo Pumping	Acre-Feet/Yr	17,600	-	17,600	$ 12.13	$ 213,488	0.185	$ 39,495
	ID-4 Pumping	Acre-Feet/Yr	25,000	-	25,000	$ 12.13	$ 303,250	0.185	$ 56,101
	ID-4 Treatment	Acre-Feet/Yr	25,000	-	25,000	$ 3.33	$ 83,250	0.185	$ 15,401
2039	Cawelo Pumping	Acre-Feet/Yr	17,600	-	17,600	$ 12.13	$ 213,488	0.174	$ 37,147
	ID-4 Pumping	Acre-Feet/Yr	25,000	-	25,000	$ 12.13	$ 303,250	0.174	$ 52,766
	ID-4 Treatment	Acre-Feet/Yr	25,000	-	25,000	$ 3.33	$ 83,250	0.174	$ 14,486

Table 16 -Water Quality and Other Expected Benefits

(All costs should be in 2009 Dollars)

Project 1: CVC to Calloway Canal Intertie

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Year	**Type of Benefit**	**Measure of Benefit (Units)**	**Without Project**	**With Project**	**Change Resulting from Project**	**Unit Value [(1)]**	**Annual Value [(1)]**	**Discount Factor [(1)]**	**Discounted Benefits [(1)]**
2040	Cawelo Pumping	Acre-Feet/Yr	17,600	-	17,600	$ 12.13	$ 213,488	0.164	$ 35,012
	ID-4 Pumping	Acre-Feet/Yr	25,000	-	25,000	$ 12.13	$ 303,250	0.164	$ 49,733
	ID-4 Treatment	Acre-Feet/Yr	25,000	-	25,000	$ 3.33	$ 83,250	0.164	$ 13,653
2041	Cawelo Pumping	Acre-Feet/Yr	17,600	-	17,600	$ 12.13	$ 213,488	0.155	$ 33,091
	ID-4 Pumping	Acre-Feet/Yr	25,000	-	25,000	$ 12.13	$ 303,250	0.155	$ 47,004
	ID-4 Treatment	Acre-Feet/Yr	25,000	-	25,000	$ 3.33	$ 83,250	0.155	$ 12,904
2042	Cawelo Pumping	Acre-Feet/Yr	17,600	-	17,600	$ 12.13	$ 213,488	0.146	$ 31,169
	ID-4 Pumping	Acre-Feet/Yr	25,000	-	25,000	$ 12.13	$ 303,250	0.146	$ 44,275
	ID-4 Treatment	Acre-Feet/Yr	25,000	-	25,000	$ 3.33	$ 83,250	0.146	$ 12,155
2043	Cawelo Pumping	Acre-Feet/Yr	17,600	-	17,600	$ 12.13	$ 213,488	0.138	$ 29,461
	ID-4 Pumping	Acre-Feet/Yr	25,000	-	25,000	$ 12.13	$ 303,250	0.138	$ 41,849
	ID-4 Treatment	Acre-Feet/Yr	25,000	-	25,000	$ 3.33	$ 83,250	0.138	$ 11,489
2044	Cawelo Pumping	Acre-Feet/Yr	17,600	-	17,600	$ 12.13	$ 213,488	0.130	$ 27,753
	ID-4 Pumping	Acre-Feet/Yr	25,000	-	25,000	$ 12.13	$ 303,250	0.130	$ 39,423
	ID-4 Treatment	Acre-Feet/Yr	25,000	-	25,000	$ 3.33	$ 83,250	0.130	$ 10,823
2045	Cawelo Pumping	Acre-Feet/Yr	17,600	-	17,600	$ 12.13	$ 213,488	0.123	$ 26,259
	ID-4 Pumping	Acre-Feet/Yr	25,000	-	25,000	$ 12.13	$ 303,250	0.123	$ 37,300
	ID-4 Treatment	Acre-Feet/Yr	25,000	-	25,000	$ 3.33	$ 83,250	0.123	$ 10,240
2046	Cawelo Pumping	Acre-Feet/Yr	17,600	-	17,600	$ 12.13	$ 213,488	0.116	$ 24,765
	ID-4 Pumping	Acre-Feet/Yr	25,000	-	25,000	$ 12.13	$ 303,250	0.116	$ 35,177
	ID-4 Treatment	Acre-Feet/Yr	25,000	-	25,000	$ 3.33	$ 83,250	0.116	$ 9,657
2047	Cawelo Pumping	Acre-Feet/Yr	17,600	-	17,600	$ 12.13	$ 213,488	0.109	$ 23,270
	ID-4 Pumping	Acre-Feet/Yr	25,000	-	25,000	$ 12.13	$ 303,250	0.109	$ 33,054
	ID-4 Treatment	Acre-Feet/Yr	25,000	-	25,000	$ 3.33	$ 83,250	0.109	$ 9,074
2048	Cawelo Pumping	Acre-Feet/Yr	17,600	-	17,600	$ 12.13	$ 213,488	0.103	$ 21,989
	ID-4 Pumping	Acre-Feet/Yr	25,000	-	25,000	$ 12.13	$ 303,250	0.103	$ 31,235
	ID-4 Treatment	Acre-Feet/Yr	25,000	-	25,000	$ 3.33	$ 83,250	0.103	$ 8,575

Table 16 -Water Quality and Other Expected Benefits (All costs should be in 2009 Dollars) Project 1: CVC to Calloway Canal Intertie									
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Year	**Type of Benefit**	**Measure of Benefit (Units)**	**Without Project**	**With Project**	**Change Resulting from Project**	**Unit Value (1)**	**Annual Value (1)**	**Discount Factor (1)**	**Discounted Benefits (1)**
2049	Cawelo Pumping	Acre-Feet/Yr	17,600	-	17,600	$ 12.13	$ 213,488	0.097	$ 20,708
	ID-4 Pumping	Acre-Feet/Yr	25,000	-	25,000	$ 12.13	$ 303,250	0.097	$ 29,415
	ID-4 Treatment	Acre-Feet/Yr	25,000	-	25,000	$ 3.33	$ 83,250	0.097	$ 8,075
2050	Cawelo Pumping	Acre-Feet/Yr	17,600	-	17,600	$ 12.13	$ 213,488	0.092	$ 19,641
	ID-4 Pumping	Acre-Feet/Yr	25,000	-	25,000	$ 12.13	$ 303,250	0.092	$ 27,899
	ID-4 Treatment	Acre-Feet/Yr	25,000	-	25,000	$ 3.33	$ 83,250	0.092	$ 7,659
2051	Cawelo Pumping	Acre-Feet/Yr	17,600	-	17,600	$ 12.13	$ 213,488	0.087	$ 18,573
	ID-4 Pumping	Acre-Feet/Yr	25,000	-	25,000	$ 12.13	$ 303,250	0.087	$ 26,383
	ID-4 Treatment	Acre-Feet/Yr	25,000	-	25,000	$ 3.33	$ 83,250	0.087	$ 7,243
2052	Cawelo Pumping	Acre-Feet/Yr	17,600	-	17,600	$ 12.13	$ 213,488	0.082	$ 17,506
	ID-4 Pumping	Acre-Feet/Yr	25,000	-	25,000	$ 12.13	$ 303,250	0.082	$ 24,867
	ID-4 Treatment	Acre-Feet/Yr	25,000	-	25,000	$ 3.33	$ 83,250	0.082	$ 6,827
2053	Cawelo Pumping	Acre-Feet/Yr	17,600	-	17,600	$ 12.13	$ 213,488	0.077	$ 16,439
	ID-4 Pumping	Acre-Feet/Yr	25,000	-	25,000	$ 12.13	$ 303,250	0.077	$ 23,350
	ID-4 Treatment	Acre-Feet/Yr	25,000	-	25,000	$ 3.33	$ 83,250	0.077	$ 6,410
2054	Cawelo Pumping	Acre-Feet/Yr	17,600	-	17,600	$ 12.13	$ 213,488	0.073	$ 15,585
	ID-4 Pumping	Acre-Feet/Yr	25,000	-	25,000	$ 12.13	$ 303,250	0.073	$ 22,137
	ID-4 Treatment	Acre-Feet/Yr	25,000	-	25,000	$ 3.33	$ 83,250	0.073	$ 6,077
2055	Cawelo Pumping	Acre-Feet/Yr	17,600	-	17,600	$ 12.13	$ 213,488	0.069	$ 14,731
	ID-4 Pumping	Acre-Feet/Yr	25,000	-	25,000	$ 12.13	$ 303,250	0.069	$ 20,924
	ID-4 Treatment	Acre-Feet/Yr	25,000	-	25,000	$ 3.33	$ 83,250	0.069	$ 5,744
2056	Cawelo Pumping	Acre-Feet/Yr	17,600	-	17,600	$ 12.13	$ 213,488	0.065	$ 13,877
	ID-4 Pumping	Acre-Feet/Yr	25,000	-	25,000	$ 12.13	$ 303,250	0.065	$ 19,711
	ID-4 Treatment	Acre-Feet/Yr	25,000	-	25,000	$ 3.33	$ 83,250	0.065	$ 5,411
2057	Cawelo Pumping	Acre-Feet/Yr	17,600	-	17,600	$ 12.13	$ 213,488	0.061	$ 13,023
	ID-4 Pumping	Acre-Feet/Yr	25,000	-	25,000	$ 12.13	$ 303,250	0.061	$ 18,498
	ID-4 Treatment	Acre-Feet/Yr	25,000	-	25,000	$ 3.33	$ 83,250	0.061	$ 5,078

Table 16 -Water Quality and Other Expected Benefits

(All costs should be in 2009 Dollars)

Project 1: CVC to Calloway Canal Intertie

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Year	**Type of Benefit**	**Measure of Benefit (Units)**	**Without Project**	**With Project**	**Change Resulting from Project**	**Unit Value (1)**	**Annual Value (1)**	**Discount Factor (1)**	**Discounted Benefits (1)**
2058	Cawelo Pumping	Acre-Feet/Yr	17,600	-	17,600	$ 12.13	$ 213,488	0.058	$ 12,382
	ID-4 Pumping	Acre-Feet/Yr	25,000	-	25,000	$ 12.13	$ 303,250	0.058	$ 17,589
	ID-4 Treatment	Acre-Feet/Yr	25,000	-	25,000	$ 3.33	$ 83,250	0.058	$ 4,829
								Total Present Value of Discounted Benefits Based on Unit Value	$ 7,822,044

Comments:

Amount of Cawelo Water Better Managed (WBM) 17,600 AF/Y

Pumping Power Cost savings per AF of Cawelo WBM $ 12.13

The cost savings of "water better managed" is based on the following:

$ 3.63 Power Billing for Pumping Plant 7 (Power billing averaged between winter and summer rates)/AF

$ 8.50 Power Billing for Pump Station A (Power billing averaged between winter and summer rates)/AF

Sum of Power Cost Benefits from Cawelo Water Better Managed: $ 2,783,243

Amount of ID-4 Water Better Managed (WBM) 25,000 AF/Y

Pumping Power Cost savings per AF of ID-4 WBM $ 12.13

The cost savings of "water better managed" is based on the following:

$ 3.63 Power Billing for Pumping Plant 7 (Power billing averaged between winter and summer rates)/AF

$ 8.50 Power Billing for Pump Station A (Power billing averaged between winter and summer rates)/AF

Sum of Power Cost Benefits from ID-4 Water Better Managed: $ 3,953,470

Amount of ID-4 Water Better Managed 25,000 AF/Y

The Treatment Cost savings of ID-4 per acre-foot better manage $ 3.33

Treatment Cost Savings provided by ID-4, based on an internal review of historical treatment cost from annual Report on Water Conditions

Sum of Treatment Cost Benefits from ID-4 Avoided Treatment: $ 1,085,330

8.2 Project 2 – Madera Avenue Intertie

Semitropic Water Storage District (Semitropic) and Shafter-Wasco Irrigation District (SWID) are proposing to construct a bi-directional water conveyance connection or intertie, identified as the *Madera Avenue Intertie* (Project), and these districts are requesting a grant under Proposition 84 to assist with funding. The intertie is intended to serve several purposes and will provide several types of benefits which include the following:

Water Supply (discussed in Attachment 7)

- Avoided Water Supply Purchases (Bring more surplus surface water into the Region); and
- Avoided Water Shortage Costs.

Water Quality and Other

- Water Quality;
- Power Cost Savings;
- Emergency Back-up; redundant means for conveying water into Semitropic and SWID;
- Reduced emissions (due to less pumping);
- Increased labor; and
- Expanded Water Banking Interconnections; provide route for CVP Delta water and SWP water to be delivered to CVP Contractors to complete banking and exchange agreements.

Water Quality and Other Benefits are analyzed below (Attachment 8). Analysis of the water supply costs and benefits are contained in ***Water Supply Costs and Benefits*** (Attachment 7).

8.2.1 Costs

Costs for Project 2 are provided in Attachment 7, no additional costs occur in order to achieve the benefits listed in Attachment 8.

8.2.2 Water Quality Benefits and Other Benefits

The water quality and other benefits associated with the Madera Avenue Intertie can be either quantified or described qualitatively and are summarized in Exhibit 8.2-1. A summary of costs and benefits is provided in Exhibit 8.2-2. For purposes of the Grant application the monetary Water Quality and Other Benefits used in the economic analysis exhibits is Reduced Power Cost. The total value of the Water Quality and Other Expected Benefits is $2,130,303.

EXHIBIT 8.2-1
Project 1 Benefit Overview

Type of Benefit	Assessment	Beneficiaries
Water Supply Benefits		
Avoided Water Supply Purchases	Monetized	Local
Avoided Water Shortage Costs	Monetized	Local
Water Quality Benefits		
Avoided damage to crops	Monetized	Local
Other Benefits		
Power Cost Savings	Monetized	Local
Emergency Back-up	Qualitative	Local
Reduced emissions	Quantitative	Local and State
Increased labor	Quantitative	Local and State
Expanded Water Banking Interconnections	Qualitative	Local, State and Federal

EXHIBIT 8.2-2
Project 2 Benefit and Cost Summary

Type of Benefit	Present Value	Qualitative Indicator
Capital and O&M Costs	**$7,603,199**	
Water Supply Benefits – See Attachment 7		
Avoided Water Supply Purchases	$9,183,750	
Avoided Water Shortage Costs	Monetized	++
Water Quality Benefits – In Attachment 8		
Avoided damage to crops	Monetized	++
Other Benefits		
Power Cost Savings	$2,130,303	
Emergency Back-up	Monetized	++
Reduced emissions	Quantitative	++
Increased labor	Quantitative	+
Expanded Water Banking Interconnections	Qualitative	+
Total Monetary Benefits	$11,314,053	
Notes: *+ indicates net benefits are likely to increase* *++ indicates net benefits are likely to increase significantly* *O&M = operations and maintenance*		

8.2.2.1 Water Quality Benefits – Avoided Damage to Crops

Groundwater beneath Kern-Tulare Water District is sodium chloride in character with total dissolved solids concentrations between 300 and 500 ppm and is classed as having medium to high salinity hazard with a very high sodium hazard. Groundwater is also high in hydrogen sulfide concentrations, which produces an objectionable odor. The danger in continued usage of groundwater is that continued pumping can cause the salt water to migrate towards useable groundwater. To prevent further degradation of the groundwater supplies to the Region, Kern Tulare must provide surface water or other supplies to its growers. If wells that are high in sodium chloride have to be used permanent damage to crops can occur resulting in reduced yields and potentially killing the crop. While the timing of this occurring is difficult to predict, if the Project did not provide additional dry-year supply and other water could not be purchased, the crops would either not be irrigated or would be irrigated with poor water quality. In any event the loss of agricultural value would be as defined in Attachment 7 for Project 2, under avoided water shortage costs. If those crops are destroyed as a result of the lack of supply or use of poor quality water, the damage value is closer to $23,000/acre as defined in Table 15 of ***Northwest Economics, Economic Impacts of the 1992 Drought Year, Kern County Water Agency, 1994***, (Appendix 9.1.1 to Attachment 9) resulting in a permanent loss of direct on-farm revenue of 3,000 acres times $23,000/acre = $69,000,000. The present value of the avoided damage to crops costs over the life of the project is not used in the benefit analysis as this could be viewed as either /or on the benefits analysis and it is anticipated growers will endeavor to find other sources of supply to stay in business. This information is provided to help explain the seriousness of the problems facing agriculture in the Poso Creek Region and will be considered as a qualitative benefit.

8.2.2.2 Power Cost Savings

The *Madera Avenue Intertie* (Project/Intertie) can be operated during wet periods to store water for CVP contractors outside the peak demand period within SWID's distribution system, in addition to other routs available to Semitropic to move water into their system. Initial design of the Project adds about 1,040 acres within Semitropic that can be reached by the Madera Avenue Pipeline. There is limited capacity in SWID's system to use the Intertie during the 4 peak irrigation months when about 60% of the demand occurs. However, during the other 8 months, the remaining 40% of the demand can be met by delivery through the Intertie. In Semitropic the irrigation demand is about 3.5 AF/acre-year. Forty percent of that demand is 1.4 AF/acre-year. Therefore, about 1,456 AF can be absorbed in Semitropic using the Intertie directly. When conveyed to storage, irrigation demands that would normally be met by pumping groundwater, would be met with surface water, thereby decreasing the amount of groundwater pumped in the district storing the water. This is referred to as in-lieu recharge. Once in storage, the water can be held in place to help in decreasing pump lifts, could be stored temporarily (seasonally for irrigation deliveries or held for dry year recovery) or could be sold/marketed to outside interests. Delivery of this water to storage in lieu of pumping groundwater will result in less water pumped from groundwater. Currently the cost to pump groundwater in Semitropic is $70/AF, from a depth of about 290 feet below ground surface (Appendix 8.2-1 Semitropic Pumping Costs). Each year that water is put into storage 1,456 acre-feet is not pumped resulting in a power cost savings of $101,920. Since water is put into storage one every three years, the average annual water not pumped is 485 acre-feet, resulting in power cost saving of about $34,000. The present worth over the 50-year life of the Project is $416,003, Table 16 – Project 2.

This can be viewed as the least amount of power cost savings for Semitropic since other routes exist for Semitropic to store water for the CVP contractors. Any time water is stored, wells are shut off thus creating the in-lieu bank account and saving power. Storage goals for groundwater banking programs are defined by the district wanting to bank the water based on their recovery capacity. Since this project can provide 7,500 AF of dry year yield a district like Kern-Tulare may want to have 6 years of water in storage, or 6 times 7,500AF/yr for 45,000 AF. Due to the size of Semitropic and their facilities to bring water into the district, the 45,000 can be absorbed in one year or over many years. In either case pumping is decreased for the full amount of water put into storage. Since the CVP banking partners would not store the water without having a firm payback program in place, the energy savings associated with storing the full 45,000 acre-feet can be attributable to the Project, $3,150,000. Since the project would refill 6 times over the 50-year life of the Project, the average annual power savings benefit is 6*$3,150,000/50 = $378,000. In addition while the water is in storage groundwater levels will be shallower than without the project. Using the 6-years of storage target about 3-years of shallower water levels occur on average. This provides about 22,500 acre-feet of water in storage as a result of the Project, on average. spreading this 45,000 acre-feet over the combined 300,000 acres of Semitropic and Shafter-Wasco, using a storage coefficient of .2, provides a lift benefit of about .4 feet ((22,500/300,000)/.2). Therefore, the power saving for growers in the two districts using power costs at $.13/kWh and 60% efficiency for the pumps, is about $.09/acre-foot (((1.025*.4)/.6)*.13). However, for purposes of the benefits calculation only the water directly delivered through the Intertie will be counted used in the Benefits calculation.

Operating the *Madera Avenue Intertie* during dry periods to recover stored water for CVP contractors can add about 7,500 acre-feet per dry year of water supply to those district's storing water in Semitropic's system. With the Project, the district storing the water does not have to pump groundwater in the dry year to make up the shortage in their surface water supplies. In Kern-Tulare for instance, the groundwater pumping levels are 550 feet below ground surface in portions of the district and pumping costs are about $140/AF (Appendix 8.2-2, Average Depth to Water). Therefore the growers in Kern-Tulare would save $1,050,000 each dry year water is provided. Since Semitropic may have to pump groundwater to pay back Kern-Tulare and the Project includes a booster pump which lifts water an additional 60 feet, there are some power costs associated with implementing the project. Those costs would be $70/AF for the water wells pumping from 290 feet below ground surface and $14/AF for the booster pump, totaling $84/AF. Deducting the operating costs from the savings provides a net savings of $140/AF - $84/AF = $56/AF. Applying that to the yield of the project ($56/AF*7,500AF), $420,000 in power costs are saved in the dry year. Since dry periods occur about once every three years on average, the average annual water supply yield is 2,500 acre-feet, resulting in a power saving associated with the recovery year of $140,000/yr. The present worth of the power savings over the life of the Project is $1,714,300, Table 16 – Project 2.

The sum of wet year and net dry year savings are about $34,000 + $140,000 = $174,000/year. The present worth of the power cost savings over the life of the Project is $2,130,303.

8.2.2.3 Emergency Back-up; redundant means for conveying water into Semitropic and SWID

As has been learned over the years, the need to have back-up conveyance systems has proven to be valuable, especially in times of disaster, power outages, critical water supply shortages, or even terrorist threats. The *Madera Avenue Intertie* Project will enable continued deliveries to the growers in Semitropic and SWID if problems were to occur at the Friant-Kern or their individual district distribution system. While it is difficult to predict the frequency of such occurrences and quantify the benefit over the life of the project, a one month loss of 16 cfs at SWID's Friant turnout during the growing season could result in a loss of about 960 acre-feet which could cause loss of 1,371 acres of crops, using 20% of the 3.5 acre-feet/acre for applied water demand (.7 AF/acre) to represent peak irrigation demand. Using the lost production values from Section 7.2.2.2, a one-time event could create as much as $3,400/acre loss or $4,661,400 in lost economic value when the 1,371 acres is affected by loss of water.

8.2.2.4 Reduced Emissions of Greenhouse Gasses

As described in Section 8.2.1.2 above, power saving occurs both on the recharge and recovery side of the project when compared to the without project conditions. Each year that water is put into storage 1,456 acre-feet is not pumped resulting in a savings of 786,240kWh in Semitropic. A typical well in Semitropic requires 300 horsepower, 225 kW and pumps at a rate of about 10 acre-feet per day. A well pumping 10 acre-feet per day requires about 540kWh/AF in energy. Therefore, 1,456 AF requires about 786,240 kWh. Use of the Project in wet years will result in saving that much energy.

In dry years the net savings in energy is the difference between pumping groundwater in Kern-Tulare and Semitropic. In this case 7,500 acre-feet would have been pumped in Kern-Tulare without the Project and is instead pumped from Semitropic. The power requirement in Kern-Tulare is about 940 kWh/AF compared to 540 kWh/AF in Semitropic. The new booster pump will require about 108 kWh/AF. The difference is about 290 kWh/AF saved energy (940-(540+108) = 292) that can be attributed to the project. For the full use of the Project 7,500AF/yr will avoid pumping from Kern Tulare in the dry years which results in lower power consumption by 2,175,000 kWh/yr (2.2 gigawatthours/year). Reduced power consumption will reduce production of greenhouse gasses. Considering that in California 0.88 pounds of carbon emissions results from each kWh of electricity produced (**Estimating Carbon Dioxide Emissions Factors for the California Electric Power Sector, Chris Marnay, Diane Fisher, Scott Murtishaw, Amol Phadke, Lynn Price, Jayant Sathaye, August 2002, Energy Analysis Department, Environmental Energy**) (Appendix 8.1-2), the Project will reduce carbon dioxide emissions by 1,914,000 pounds per dry year. In total, over the life of the Project, approximately 31,900,000 pounds of carbon dioxide emissions will be avoided with the Project (1,914,000/3*50).

8.2.2.5 Increased Labor

The ***Howitt et al*** report was updated in September 2009***, Measuring the Employment Impact of Water Reductions, Richard Howitt, Josue Medellin-Azuara, Duncan MacEwan, Department of Agriculture and Resource Economics and Center for Watershed Sciences, University of California, Davis, September 28, 2009.*** The report equates jobs lost to agricultural production value lost. The revised report concludes that as many as 30 jobs are lost per million dollars in lost farm production. Therefore, 30 times $10.2 million = 306 jobs will not be lost each dry year if the project were implemented. These jobs are extremely important due to the high unemployment experienced in the Poso Creek Regions disadvantaged communities.

8.2.2.6 Expanded Water Banking Interconnections; provide route for CVP Delta water and SWP water to be delivered to CVP Contractors to complete banking and exchange agreements

Semitropic has a long established groundwater banking program capable of storing water for districts throughout the state of California. One component lacking from the Semitropic Programs have been the ability to convey dry year supply to Federal Districts with access to the Friant-Kern Canal. The *Madera Avenue Intertie* provides a linkage to move up to 7,500 acre-feet per year into the Friant-Kern by exchange with SWID. Many years that capacity is taken up with programs for the primary beneficiaries, Kern Tulare, SWID and Delano-Earlimart, however there are times when the facilities may be available for others. The primary programs outlined by the districts and exchange partners result in about 7,500 acre-feet of use during a dry year. Once those participants recover their target storage or if the year is not dry enough for them to need to call on the water, that capacity can be made available to others. For example, water from the San Joaquin Settlement which is run down the San Joaquin River to the Delta can be conveyed into Semitropic and reregulated for the Friant-Kern contractors. The Intertie can also have the potential to help manage timing of pumping from the Delta for both the CVP (San Joaquin Settlement returned water) and SWP water. Different starting contract months can allow use this interconnection to manage some of the supplies out of the Delta depending on water availability out of San Luis Reservoir. While these programs have not been thoroughly analyzed, qualitatively the benefits of the *Madera Avenue Intertie* can become a component of statewide programs.

8.2.3 Distribution of Benefits and Identification of Beneficiaries

Reduced electricity demand will benefit the Region by reduced demand on the grid and increased energy reliability. The reduction of power use and thus costs will directly benefit water users in the area. The reduction in carbon dioxide emissions will benefit the residents of California. Reduced carbon emissions is a goal of the State of California as reflected in *Assembly Bill 32, Global Warming Solutions Act of 2006* . Labor increases will benefit the regions disadvantaged communities all of which are within the Poso Creek Region. Improved water banking interconnectivity will benefit local, regional, and statewide water management programs.

8.2.4 Benefits Timeline

The estimated life of the Project is over the entire period of analysis, which is 50 years beginning in 2011. The Project will begin in 2011, and full potential benefits will accrue in full upon completion in 2014.

8.2.5 Uncertainties

The benefits defined are based on the best available information regarding availability of Friant-Kern and Delta CVP supplies and historic operations of the water districts involved. Changes impacting operations of the CVP and the ability to pump from the Delta could change the availability of supplies and therefore the water supply benefits estimated. Therefore there is uncertainty regarding the benefits of power reduction and improved air quality. Current benefit descriptions are based on estimates of future exchanges and water supply conditions that have occurred in the past. Climate change and other factors may change the opportunity of exchanges. These uncertainties can result in more water or less water moved through the Project. Adding flexibility to water conveyance systems is the most prudent activity to do in order to be prepared for the uncertain future.

8.2.6 Potential Adverse Effects

The Project will cause temporary disturbances of land surfaces during construction that will be mitigated, and there are no long-term adverse impacts expected as a result of the Project. Any unforeseen temporary impacts will be mitigated.

8.2.7 Summary of Findings

Project benefits will occur from reduced electricity demand, and the reduced emissions resulting from the reduction in energy requirements. Power savings are likely to cause a benefit to water system operators estimated to be $2,130,303. Improved water quality, air quality, jobs and water management are only discussed qualitatively; monetized benefits claimed for these benefits are not provided. However the value of the project can be looked at in many ways and the need is demonstrated by the consequences defined by not implementing the Project.

8.2.8 Appendices

Appendix 8.2-1	Semitropic Pumping Costs
Appendix 8.2-2	Average Depth to Water

8.2.9 Tables

Table 16 – Project 2	Water Quality and Other Benefits

App 8.2-1 Semitropic Pumping Costs

Summary Page for Landowners on SWSD Power.

Month	Total Cost	Total AF	$ / AF	Total kwh's
April	$28,280.04	414.22	$68.27	170,961
May	$79,117.66	926.71	$85.37	540,960
June	$134,884.85	1,635.66	$82.47	907,220
July	$126,019.65	1,399.73	$90.03	882,272
15-Aug	$74,007.79	1,010.14	$73.26	467,338
31-Aug	$30,494.85	547.48	$55.70	246,301
September	$77,729.26	1,309.00	$59.38	620,214
October	$140,348.98	2,473.81	$56.73	1,106,631
November	$153,576.36	2,695.69	$56.97	1,212,280
December	$210,463.13	3,429.98	$61.36	1,693,033
January	$211,935.61	3,519.14	$60.22	1,697,047
Total of Landowner Wells	**$1,266,858.18**	**19,361.56**	**$65.43**	**9,544,257**

Summary Page for Landowners on PG&E or other Electrical Power.

Month	Total Cost	Total AF	$ / AF	Total kwh's
April	$12,655.74	96.63	$130.97	94,063
May	$26,340.21	318.07	$82.81	153,622
June	$36,830.60	447.40	$82.32	231,478
July	$116,209.31	1,306.13	$88.97	729,460
15-Aug	$126,213.66	1,556.45	$81.09	732,341
31-Aug	$117,816.33	1,014.42	$116.14	965,332
September	$235,025.40	3,767.95	$62.37	1,746,486
October	$407,075.06	6,601.63	$61.66	3,003,411
November	$428,047.83	7,424.11	$57.66	3,700,784
December	$457,504.10	7,759.71	$58.96	4,320,895
January	$445,400.09	6,643.80	$67.04	4,157,861
Total of Landowner Wells	**$2,409,118.33**	**36,936.30**	**$65.22**	**19,835,733**

Summary Page for landowners on Diesel or Natural Gas. (Possible electric Booster)

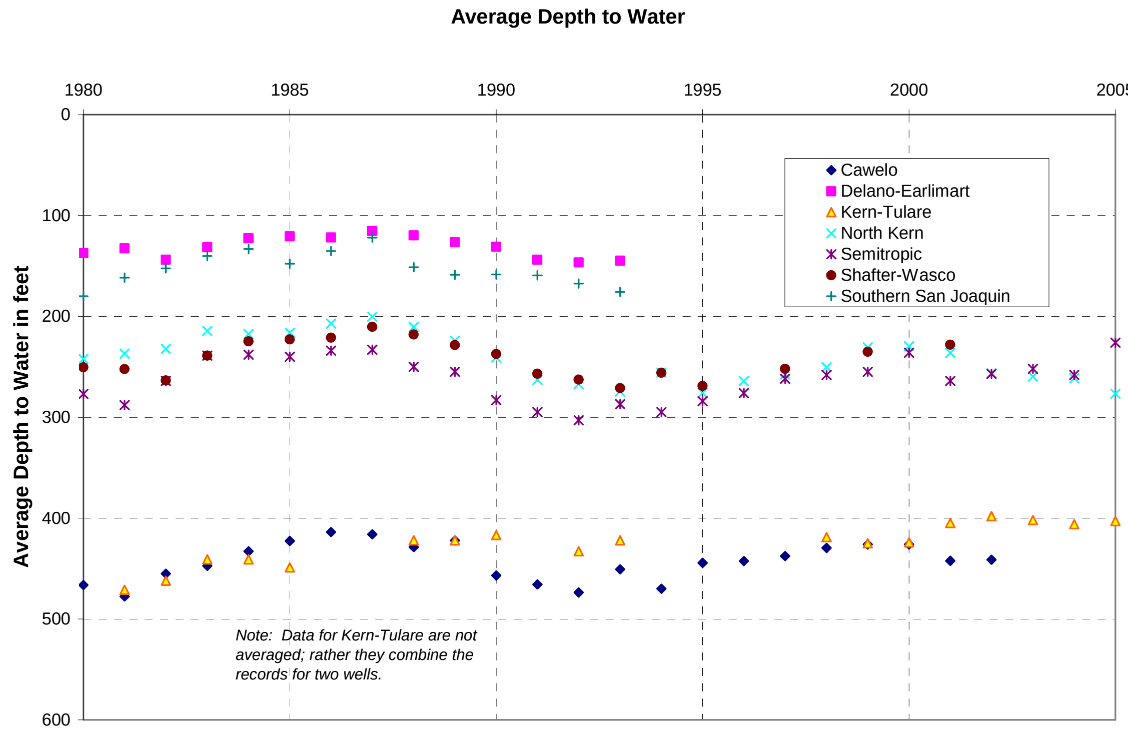
Month	Total Cost	Total AF	$ / AF	Total kwh's
April	$0.00	0.00		0
May	$0.00	0.00		0
June	$16,659.51	104.60	$159.27	56,243
July	$116,538.77	844.97	$137.92	454,337
15-Aug	$144,358.31	1,087.59	$132.73	584,792
31-Aug	$134,168.54	1,061.77	$126.36	570,909
September	$433,943.78	3,587.51	$120.96	1,928,989
October	$651,932.53	5,591.78	$116.59	3,006,676
November	$806,899.72	6,737.39	$119.76	3,622,666
December	$623,192.58	5,367.08	$116.11	2,885,856
January	$705,955.55	6,058.87	$116.52	3,257,828
Total of Landowner Wells	**$3,633,649.29**	**30,441.56**	**$119.36**	**16,368,297**

Total Summary Page for all Landowners estimated cost.

Month	Total Cost	Total AF	$ / AF	Total kwh's
April	$40,935.78	$510.85	$80.13	265,024
May	$105,457.87	1,244.78	$84.72	694,582
June	$188,374.96	2,187.66	$86.11	1,194,941
July	$358,767.73	3,550.83	$101.04	2,066,069
15-Aug	$344,579.76	3,654.18	$94.30	1,784,472
31-Aug	$282,479.72	2,623.67	$107.67	1,782,542
September	$746,698.44	8,664.46	$86.18	4,295,689
October	$1,199,356.57	14,667.22	$81.77	7,116,718
November	$1,388,523.91	16,857.19	$82.37	8,535,730
December	$1,291,159.81	16,556.77	$77.98	8,899,784
January	$1,363,291.25	16,221.81	$84.04	9,112,736
Total of Landowner Wells	**$7,309,625.80**	**86,739.42**	**$84.27**	**45,748,287**
Total of SWSD Wells	**$2,027,995.81**	**50,473.48**	**$40.18**	**24,819,432**
Total Recovery Cost To Surface	**$9,337,621.61**	**137,212.90**	**$68.05**	**70,567,719**

Total Cost of Banking Recovery to surface	**$12,058,145.67**	**177,190**	**$68.05**
Cost To Pump water to Aqueduct	**$1,475,109.41**	**106,190.00**	**$13.89**

Total Cost of Exchange Water	**$4,831,696.73**	**71,000.00**	**$68.05**
Total Cost for Water Pumped to Aqueduct	**$8,701,558.35**	**106,190.00**	**$81.94**
Total	**$13,533,255.08**	**177,190.00**	


Average Depth to Water
Average Depth to Water in feet
1980
1985
1990
1995
2000
2005
0
100
200
300
400
500
600
Cawelo
Delano-Earlimart
Kern-Tulare
North Kern
Semitropic
Shafter-Wasco
Southern San Joaquin
Note: Data for Kern-Tulare are not averaged; rather they combine the records for two wells.

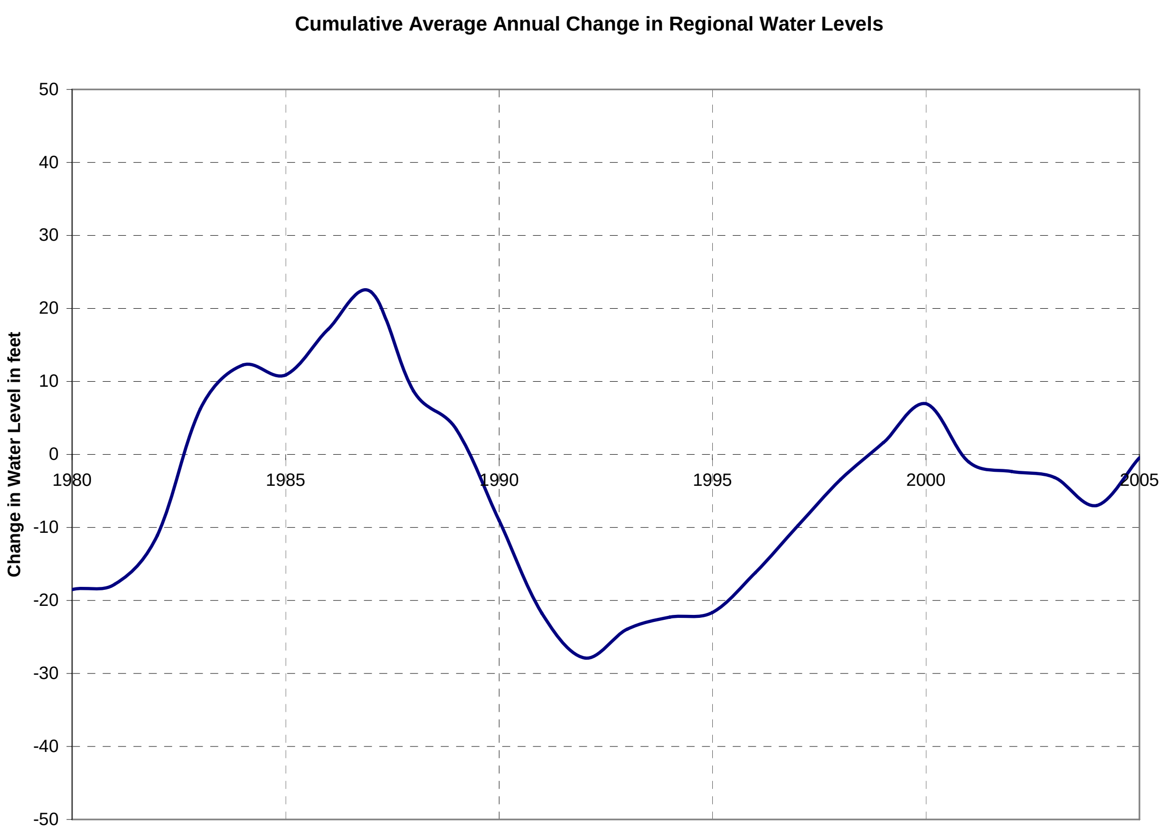

Cumulative Average Annual Change in Regional Water Levels
Change in Water Level in feet
50
40
30
20
10
0
-10
-20
-30
-40
-50
1980
1985
1990
1995
2000
2005

Table 16 -Water Quality and Other Expected Benefits
(All costs should be in 2009 Dollars)

Project 2: Madera Avenue Intertie

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Year	**Type of Benefit**	**Measure of Benefit (Units)**	**Without Project**	**With Project**	**Change Resulting from Project**	**Unit Value (1)**	**Annual Value (1)**	**Discount Factor (1)**	**Discounted Benefits (1)**
2009								1.000	$ -
2010								0.943	
2011								0.890	
2012								0.840	
2013								0.792	
2014	Power Cost Savings - Recharge	$/AF	$70.00	$0.00	$ 70.00	485	$ 33,973	0.747	$ 25,378
	Power Cost Savings - Recovery	$/AF	$140.00	$84.00	$ 56.00	2,500	$ 140,000	0.747	$ 104,580
2015	Recharge	$/AF	$70.00	$0.00	$ 70.00	485	$ 33,973	0.705	$ 23,951
	Recovery	$/AF	$140.00	$84.00	$ 56.00	2,500	$ 140,000	0.705	$ 98,700
2016	Recharge	$/AF	$70.00	$0.00	$ 70.00	485	$ 33,973	0.665	$ 22,592
	Recovery	$/AF	$140.00	$84.00	$ 56.00	2,500	$ 140,000	0.665	$ 93,100
2017	Recharge	$/AF	$70.00	$0.00	$ 70.00	485	$ 33,973	0.627	$ 21,301
	Recovery	$/AF	$140.00	$84.00	$ 56.00	2,500	$ 140,000	0.627	$ 87,780
2018	Recharge	$/AF	$70.00	$0.00	$ 70.00	485	$ 33,973	0.592	$ 20,112
	Recovery	$/AF	$140.00	$84.00	$ 56.00	2,500	$ 140,000	0.592	$ 82,880
2019	Recharge	$/AF	$70.00	$0.00	$ 70.00	485	$ 33,973	0.558	$ 18,957
	Recovery	$/AF	$140.00	$84.00	$ 56.00	2,500	$ 140,000	0.558	$ 78,120
2020	Recharge	$/AF	$70.00	$0.00	$ 70.00	485	$ 33,973	0.527	$ 17,904
	Recovery	$/AF	$140.00	$84.00	$ 56.00	2,500	$ 140,000	0.527	$ 73,780
2021	Recharge	$/AF	$70.00	$0.00	$ 70.00	485	$ 33,973	0.497	$ 16,885
	Recovery	$/AF	$140.00	$84.00	$ 56.00	2,500	$ 140,000	0.497	$ 69,580

Table 16 -Water Quality and Other Expected Benefits
(All costs should be in 2009 Dollars)

Project 2: Madera Avenue Intertie

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Year	**Type of Benefit**	**Measure of Benefit (Units)**	**Without Project**	**With Project**	**Change Resulting from Project**	**Unit Value (1)**	**Annual Value (1)**	**Discount Factor (1)**	**Discounted Benefits (1)**
2022	Recharge	$/AF	$70.00	$0.00	$ 70.00	485	$ 33,973	0.469	$ 15,933
	Recovery	$/AF	$140.00	$84.00	$ 56.00	2,500	$ 140,000	0.469	$ 65,660
2023	Recharge	$/AF	$70.00	$0.00	$ 70.00	485	$ 33,973	0.442	$ 15,016
	Recovery	$/AF	$140.00	$84.00	$ 56.00	2,500	$ 140,000	0.442	$ 61,880
2024	Recharge	$/AF	$70.00	$0.00	$ 70.00	485	$ 33,973	0.417	$ 14,167
	Recovery	$/AF	$140.00	$84.00	$ 56.00	2,500	$ 140,000	0.417	$ 58,380
2025	Recharge	$/AF	$70.00	$0.00	$ 70.00	485	$ 33,973	0.394	$ 13,385
	Recovery	$/AF	$140.00	$84.00	$ 56.00	2,500	$ 140,000	0.394	$ 55,160
2026	Recharge	$/AF	$70.00	$0.00	$ 70.00	485	$ 33,973	0.371	$ 12,604
	Recovery	$/AF	$140.00	$84.00	$ 56.00	2,500	$ 140,000	0.371	$ 51,940
2027	Recharge	$/AF	$70.00	$0.00	$ 70.00	485	$ 33,973	0.350	$ 11,891
	Recovery	$/AF	$140.00	$84.00	$ 56.00	2,500	$ 140,000	0.350	$ 49,000
2028	Recharge	$/AF	$70.00	$0.00	$ 70.00	485	$ 33,973	0.331	$ 11,245
	Recovery	$/AF	$140.00	$84.00	$ 56.00	2,500	$ 140,000	0.331	$ 46,340
2029	Recharge	$/AF	$70.00	$0.00	$ 70.00	485	$ 33,973	0.312	$ 10,600
	Recovery	$/AF	$140.00	$84.00	$ 56.00	2,500	$ 140,000	0.312	$ 43,680
2030	Recharge	$/AF	$70.00	$0.00	$ 70.00	485	$ 33,973	0.294	$ 9,988
	Recovery	$/AF	$140.00	$84.00	$ 56.00	2,500	$ 140,000	0.294	$ 41,160
2031	Recharge	$/AF	$70.00	$0.00	$ 70.00	485	$ 33,973	0.278	$ 9,445
	Recovery	$/AF	$140.00	$84.00	$ 56.00	2,500	$ 140,000	0.278	$ 38,920
2032	Recharge	$/AF	$70.00	$0.00	$ 70.00	485	$ 33,973	0.262	$ 8,901
	Recovery	$/AF	$140.00	$84.00	$ 56.00	2,500	$ 140,000	0.262	$ 36,680

Table 16 -Water Quality and Other Expected Benefits
(All costs should be in 2009 Dollars)

Project 2: Madera Avenue Intertie

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Year	**Type of Benefit**	**Measure of Benefit (Units)**	**Without Project**	**With Project**	**Change Resulting from Project**	**Unit Value (1)**	**Annual Value (1)**	**Discount Factor (1)**	**Discounted Benefits (1)**
2033	Recharge	$/AF	$70.00	$0.00	$ 70.00	485	$ 33,973	0.247	$ 8,391
	Recovery	$/AF	$140.00	$84.00	$ 56.00	2,500	$ 140,000	0.247	$ 34,580
2034	Recharge	$/AF	$70.00	$0.00	$ 70.00	485	$ 33,973	0.233	$ 7,916
	Recovery	$/AF	$140.00	$84.00	$ 56.00	2,500	$ 140,000	0.233	$ 32,620
2035	Recharge	$/AF	$70.00	$0.00	$ 70.00	485	$ 33,973	0.220	$ 7,474
	Recovery	$/AF	$140.00	$84.00	$ 56.00	2,500	$ 140,000	0.220	$ 30,800
2036	Recharge	$/AF	$70.00	$0.00	$ 70.00	485	$ 33,973	0.207	$ 7,032
	Recovery	$/AF	$140.00	$84.00	$ 56.00	2,500	$ 140,000	0.207	$ 28,980
2037	Recharge	$/AF	$70.00	$0.00	$ 70.00	485	$ 33,973	0.196	$ 6,659
	Recovery	$/AF	$140.00	$84.00	$ 56.00	2,500	$ 140,000	0.196	$ 27,440
2038	Recharge	$/AF	$70.00	$0.00	$ 70.00	485	$ 33,973	0.185	$ 6,285
	Recovery	$/AF	$140.00	$84.00	$ 56.00	2,500	$ 140,000	0.185	$ 25,900
2039	Recharge	$/AF	$70.00	$0.00	$ 70.00	485	$ 33,973	0.174	$ 5,911
	Recovery	$/AF	$140.00	$84.00	$ 56.00	2,500	$ 140,000	0.174	$ 24,360
2040	Recharge	$/AF	$70.00	$0.00	$ 70.00	485	$ 33,973	0.164	$ 5,572
	Recovery	$/AF	$140.00	$84.00	$ 56.00	2,500	$ 140,000	0.164	$ 22,960
2041	Recharge	$/AF	$70.00	$0.00	$ 70.00	485	$ 33,973	0.155	$ 5,266
	Recovery	$/AF	$140.00	$84.00	$ 56.00	2,500	$ 140,000	0.155	$ 21,700
2042	Recharge	$/AF	$70.00	$0.00	$ 70.00	485	$ 33,973	0.146	$ 4,960
	Recovery	$/AF	$140.00	$84.00	$ 56.00	2,500	$ 140,000	0.146	$ 20,440
2043	Recharge	$/AF	$70.00	$0.00	$ 70.00	485	$ 33,973	0.138	$ 4,688
	Recovery	$/AF	$140.00	$84.00	$ 56.00	2,500	$ 140,000	0.138	$ 19,320

Table 16 -Water Quality and Other Expected Benefits
(All costs should be in 2009 Dollars)
Project 2: Madera Avenue Intertie

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Year	**Type of Benefit**	**Measure of Benefit (Units)**	**Without Project**	**With Project**	**Change Resulting from Project**	**Unit Value (1)**	**Annual Value (1)**	**Discount Factor (1)**	**Discounted Benefits (1)**
2044	Recharge	$/AF	$70.00	$0.00	$ 70.00	485	$ 33,973	0.130	$ 4,417
	Recovery	$/AF	$140.00	$84.00	$ 56.00	2,500	$ 140,000	0.130	$ 18,200
2045	Recharge	$/AF	$70.00	$0.00	$ 70.00	485	$ 33,973	0.123	$ 4,179
	Recovery	$/AF	$140.00	$84.00	$ 56.00	2,500	$ 140,000	0.123	$ 17,220
2046	Recharge	$/AF	$70.00	$0.00	$ 70.00	485	$ 33,973	0.116	$ 3,941
	Recovery	$/AF	$140.00	$84.00	$ 56.00	2,500	$ 140,000	0.116	$ 16,240
2047	Recharge	$/AF	$70.00	$0.00	$ 70.00	485	$ 33,973	0.109	$ 3,703
	Recovery	$/AF	$140.00	$84.00	$ 56.00	2,500	$ 140,000	0.109	$ 15,260
2048	Recharge	$/AF	$70.00	$0.00	$ 70.00	485	$ 33,973	0.103	$ 3,499
	Recovery	$/AF	$140.00	$84.00	$ 56.00	2,500	$ 140,000	0.103	$ 14,420
2049	Recharge	$/AF	$70.00	$0.00	$ 70.00	485	$ 33,973	0.097	$ 3,295
	Recovery	$/AF	$140.00	$84.00	$ 56.00	2,500	$ 140,000	0.097	$ 13,580
2050	Recharge	$/AF	$70.00	$0.00	$ 70.00	485	$ 33,973	0.092	$ 3,126
	Recovery	$/AF	$140.00	$84.00	$ 56.00	2,500	$ 140,000	0.092	$ 12,880
2051	Recharge	$/AF	$70.00	$0.00	$ 70.00	485	$ 33,973	0.087	$ 2,956
	Recovery	$/AF	$140.00	$84.00	$ 56.00	2,500	$ 140,000	0.087	$ 12,180
2052	Recharge	$/AF	$70.00	$0.00	$ 70.00	485	$ 33,973	0.082	$ 2,786
	Recovery	$/AF	$140.00	$84.00	$ 56.00	2,500	$ 140,000	0.082	$ 11,480
2053	Recharge	$/AF	$70.00	$0.00	$ 70.00	485	$ 33,973	0.077	$ 2,616
	Recovery	$/AF	$140.00	$84.00	$ 56.00	2,500	$ 140,000	0.077	$ 10,780
2054	Recharge	$/AF	$70.00	$0.00	$ 70.00	485	$ 33,973	0.073	$ 2,480
	Recovery	$/AF	$140.00	$84.00	$ 56.00	2,500	$ 140,000	0.073	$ 10,220

Table 16 -Water Quality and Other Expected Benefits

(All costs should be in 2009 Dollars)

Project 2: Madera Avenue Intertie

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Year	**Type of Benefit**	**Measure of Benefit (Units)**	**Without Project**	**With Project**	**Change Resulting from Project**	**Unit Value (1)**	**Annual Value (1)**	**Discount Factor (1)**	**Discounted Benefits (1)**
2055	Recharge	$/AF	$70.00	$0.00	$ 70.00	485	$ 33,973	0.069	$ 2,344
	Recovery	$/AF	$140.00	$84.00	$ 56.00	2,500	$ 140,000	0.069	$ 9,660
2056	Recharge	$/AF	$70.00	$0.00	$ 70.00	485	$ 33,973	0.065	$ 2,208
	Recovery	$/AF	$140.00	$84.00	$ 56.00	2,500	$ 140,000	0.065	$ 9,100
2057	Recharge	$/AF	$70.00	$0.00	$ 70.00	485	$ 33,973	0.061	$ 2,072
	Recovery	$/AF	$140.00	$84.00	$ 56.00	2,500	$ 140,000	0.061	$ 8,540
2058	Recharge	$/AF	$70.00	$0.00	$ 70.00	485	$ 33,973	0.058	$ 1,970
	Recovery	$/AF	$140.00	$84.00	$ 56.00	2,500	$ 140,000	0.058	$ 8,120
Total Present Value of Discounted Benefits Based on Unit									$ 2,130,303

Comments:

Power Cost Savings - Recharge (Recharge)

Recharge Water	$ 485.33	AF/Y
Power Costs During Recharge (Without Project)	$ 70.00	/AF
Power Costs During Recharge (With Project)	$ -	/AF
Sum of Power Cost Benefits from Recharge Power Cost Savings	$ 416,003	

Power Cost Savings - Recovery (Recovery)

Recovered Water	$ 2,500.00	AF/Y
Power Costs During Recovery (Without Project)	$ 140.00	/AF
Power Costs During Recovery (With Project)	$ 84.00	/AF
ɔum of Power Cost Benefits from Recovery Power Cost Savings	$ 1,714,300	

8.3 Project 3 – Habitat Improvements on Pond-Poso and Turnipseed Spreading Basins

Project 3 would add wildlife habitat along the margins of Pond-Poso and Turnipseed Spreading Basins in two locations within the Poso Creek IRWM Region. Specifically a total of 547 acres of habit would be created including the following habitats; 513 acres of wetland type habitat and 34 acres of riparian type habitat:

- 443 Acres of wetland habitat along the margin or within the shallow-pond areas within the Spreading Basin areas
- 31.3 Acres of emergent and riparian habitat along the margin of the created wetland habitat in the Spreading Basin areas
- 70 Acres of wetland habitat along the margin or within the shallow-pond areas within DEID's Turnipseed Spreading Basin
- 2.7 Acres of emergent and riparian habitat along the margin of the created wetland habitat in DEID's Turnipseed Spreading Basin

8.3.1 Costs

The Habitat Improvement on Pond-Poso and Turnipseed Spreading Basins Project has an estimated project cost of $117,430. The Poso Creek RWMG is requesting $87,910 in Prop 84 Implementation Grant Funding.

8.3.2 Water Quality and Other Benefits

The benefits of Project 3 include enhanced environmental resources, multiple water uses for existing supply, enhanced aesthetic values, and improved quality of infiltrated water. The benefits are summarized in Exhibits 8.3-1 and 8.3-2.

Exhibit 8.3-1
Project 3, Habitat Improvements on Pond-Poso and Turnipseed Spreading Basins

Type of Benefit	Assessment	Beneficiaries
Water Supply Benefits		
Multiple water uses for existing supply	Qualitative	Local
Water Quality Benefits		
Improved quality of infiltrated water	Qualitative	Local
Other Benefits		
Enhanced environmental resources	Qualitative	Local Regional
Enhanced aesthetic values	Qualitative	Local

Exhibit 8.3-2
Project 3, Habitat Improvements on Pond-Poso and Turnipseed Spreading Basins

Type of Benefits/Costs	Present Value
Capital and O&M Costs	
Quantitative Benefits	
Enhanced environmental resources	Establishment of 513 acres of wetland and 34 acres of riparian habitat. Value not monetized.
Qualitative Benefits	**Qualitative Indicator**
Multiple water uses for existing supply	Expanded wetland and riparian habitat utilizing water diverted for ground-water recharge. +
Improved quality of infiltrated water	Removal of nitrates and other contaminants by biological activity +
Enhanced aesthetic values	Establishment of habitat with trees and shrubs to add variation to near-and mid distance views ++

Notes:
+ indicates net benefits are likely to increase
++ indicates net benefits are likely to increase significantly
O&M = operations and maintenance

8.3.2.1 Improved Water Quality

Without the project water delivered to the spreading grounds would be infiltrated directly into site soils. With the project, wetlands plants would take up some nutrients and other dissolved contaminants as the water is percolated. Thus there would be an improvement in ground-water quality with the project.

In particular, NO3 in water supplies has serious health effects. Thus reducing sources of NO3 in ground-water sources would have direct benefits to local residents' health, and may address an environmental justice issue.

8.3.2.2 Other Benefits

Enhanced Environmental Resources

Several other benefits can be attributed to establishing wetlands and uplands habitat; they include enhanced environmental resources and enhanced aesthetic values. The wetland and riparian restoration would result in a "patchwork" of large open wetlands separated by linear areas of trees and shrubs. This arrangement will mimic the physical structure of riparian vegetation and increase the value of the plantings as habitat. The total acreages are significant because they are large enough in area to provide viable habitat to a substantial number of species.

The enhanced habitat is particularly important because this region has lost 90-95% of its native habitat. As a result, more than 120 special status species found the Region are in need of protection. I n addition, the Tulare Basin has the smallest proportion of protected natural land and one of the smallest percentages of public recreational land per capita of any region in California. Unfortunately there is no clear basis with which to monetize the benefits of new wetlands and riparian habitat in this area.

Enhanced Aesthetic values

In addition to its habitat value, the trees and shrubs established by Project 3 would provide enhanced aesthetic values to the view shed around the restoration areas. Tall vegetation (trees and shrubs) will be visible and will provide near- and mid- field diversity to views along public roads.

8.3.3 Distribution of Benefits and Identification of Beneficiaries

Adding wildlife habitat along the margins of Pond-Poso and Turnipseed Spreading Basins will have local benefits of improving water quality, and aesthetics. Providing additional wetland and adjacent uplands habitat will have regional and state level benefits to endangered and sensitive species.

8.3.4 Benefits Timeline

Initial establishment of wildlife habitat along the margins of Pond-Poso and Turnipseed Spreading Basins will require 2 years. The estimated life of the project is 40 years. The Project will begin in 2011 with site grading and wetland plantings and benefits of environmental improvements will begin late in year 2011. As the plantings become established and shrubs and trees in the uplands areas become mature, the full benefits of the diverse habitat will be realized. These full benefits may be realized within 5 to 10 years.

8.3.5 Uncertainties

There is uncertainty regarding the benefits of improved water quality. The levels and timing of improvement are uncertain. The level of current health costs due to poor water quality and potential health improvements are not known.

8.3.6 Potential Adverse Effects

The grading will cause minor temporary disturbances in previously disturbed areas. No long term impacts expected as a result of the Project. Any unforeseen temporary impacts will be mitigated.

8.3.7 Summary of Findings

Project benefits will occur from the improved water quality and avoided health costs. Because these benefits are only discussed qualitatively, monetized benefits claimed for this Project cannot be estimated, but may be significant in the long run due to improved health.

8.3.8 Appendices

There are no appendices for this Section.

8.3.9 Tables

There are no tables for this Section

8.4 Project 4 – On-Farm Mobile Lab, Water Use Efficiency Services

Project 4 would provide on-farm Mobile Lab evaluation of irrigation systems by North West Kern Resource Conservation District (NWKRCD) through its Water Use Efficiency Services. Overall they will provide irrigation efficiency assessments to at least 12,000 acres in the Region. The Mobile Lab will provide assistance to agricultural landowners in the Region that consists of on-farm irrigation system evaluations and would be available to farms of all sizes. Contact will be made directly with growers that might benefit from an on-farm analysis within water districts of the Region. On-site follow-ep assessments are made to evaluate the increase in efficiency due to implementation of recommended measures.

8.4.1 Costs

The On-Farm Mobile Lab, Water Use Efficiency Services Project (Project 4 or Project) has an estimated project cost of $300,240. The Poso Creek RWMG is requesting $100,000 in Prop 84 Implementation Grant funding.

8.4.2 Water Quality and Other Benefits

The benefits of on-farm Mobile Lab evaluation in the Poso Creek Region include increased water supply reliability, minimize water supply costs and improved water quality. Direct benefits include increased water supply reliability as well as minimized water supply costs due to improved water use efficiency and less energy used.

Indirect benefits include improved ground-water quality due to unnecessary application of nutrients and subsequent leaching to ground water. The benefits associated with Project are summarized in Exhibits 8.4-1 and 8.4-2.

Exhibit 8.4-1
Project 4 Benefit Overview

Type of Benefit	Assessment	Beneficiaries
Water Supply Benefits		
Increase water supply reliability. (Attachment 7)	Qualitative	Local
Other Benefits		
improved ground-water quality	Qualitative	Local
Reduced/avoided operating costs	Qualitative	Local

Exhibit 8.4-2
Project 4 Benefit and Cost Summary

Type of Benefits/Costs	Present Value
Capital and O&M Costs	$300,240
Qualitative Benefits	**Qualitative Indicator**
Improved quality of ground-water	Qualitative +
Reduced/avoided operating costs	Qualitative +
Increase water supply reliability.	Qualitative ++
Notes: *+ indicates net benefits are likely to increase* *++ indicates net benefits are likely to increase significantly* *O&M = operations and maintenance*	

8.4.2.1 Improved Ground-water Quality

With the Project, the quality of water percolating beyond the root zone and recharging aquifers will be improved. More efficient application of water will allow more precise application of nutrients avoiding excess nutrients in soils. Excess nutrients would be mobilized and percolated downward in areas of over irrigation.

8.4.2.2 Reduced/Avoided Operating Costs

In the Poso Creek Region, energy costs associated with irrigation range from $70 to $140 per acre-foot of applied water. The project would reduce the amount of water applied by improving efficiency of irrigation systems. Because the degree of improvements cannot be estimated, no monetized benefit can be calculated.

8.4.3 Distribution of Benefits and Identification of Beneficiaries

The improved irrigation efficiency would benefit all water users in the Region. Improvements in water quality would benefit all residents within the Region as well.

8.4.4 Benefits Timeline

The estimated life of the Project is 2 years, however benefits would continue over the entire period of analysis, which is 20 years beginning in 2011. The Project will begin in 2011, and benefits will begin to accrue immediately and increase throughout the 2 years of implementation.

8.4.5 Uncertainties

There is uncertainty regarding the percent efficiency improvements expected in the various water systems to be evaluated.

8.4.6 Potential Adverse Effects

The Project will cause no adverse impacts.

8.4.7 Summary of Findings

Project benefits due to on-farm Mobile Lab evaluation of irrigation systems include increased water supply reliability, minimize water supply costs and improved water quality. Direct benefits include increased water supply reliability and minimized water supply costs. Indirect benefits include improved ground-water quality.

8.4.8 Appendices

There are no appendices for this Section.

8.4.9 Tables

There are no tables for this Section

8.5 Project 5 – DAC Fund for Feasibility-Level Studies and Well Destruction Program

Project 5 will address critical water supply needs in Disadvantaged Communities (DACs) by providing funding for project development and proper well destruction not available from other sources.   Project funding will be used to:

1. Perform feasibility studies, environmental and engineering work necessary to construct facilities to solve defined water supply problems in the 5 DACs, and
2. Buy down the cost of destroying unused wells that pose a threat to DAC water supplies.

The DAC communities do not have the resources to fund feasibility studies, environmental and engineering work needed to seek and secure future grant funding to construct facilities that would mitigate water quality concerns. As a result of the project, each DAC will have the necessary materials to proceed with application for project construction funding and subsequently request construction bids.

Agricultural owners often regard unused wells as potential backup in the event that additional supplies are needed. However, many of these older wells were often constructed without regard to isolating poor quality zones and deteriorate with time, in either case potentially allowing poor quality water to enter higher quality production zones. This can contribute significantly to water quality problems in near-by urban supply wells. Two common contaminants in DAC water supply wells are Arsenic and Nitrate which are regulated by health standards.

8.5.1 Costs

The DAC Fund for Feasibility-Level Studies and Well Destruction Program (Project 5 or Project) has an estimated project cost of $431,740. The Poso Creek Regional Water Management Group (Poso RWMG) is requesting $400,000 in Prop 84 Implementation Grant funding.

Water Quality and Other Benefits

Benefits of Feasibility and Engineering Studies

The benefits of providing funding to develop 5 DAC projects include improvement of supply reliability, financial sustainability for DAC water systems improvement of water quality, and protection of public health. Direct benefits include increased property values, and reduced medical health costs. The benefits associated with developing DAC benefits are summarized in Exhibits 8.5-1 and 8.5-2.

EXHIBIT 8.5-1
Project 5 DAC Project Development Benefit Overview

Type of Benefit	Assessment	Beneficiaries
Water Supply Benefits		
Increased Water Supply Reliability	Qualitative	Local
Water Quality Benefits		
Improved Quality In Potable Supply	Qualitative	Local
Other Benefits		
Reduced Medical Health Costs		
Increased Property Values	Qualitative	Local
Improved Disposal Of Treatment Residue (Lost Hills)	Qualitative	Local

EXHIBIT 8.5-2
Project 5 DAC Project Development Benefit and Cost Summary

Type of Benefits/Costs	Present Value
Capital and O&M Costs	$729,260
Quantitative Benefits	
Increased Property Values	Qualitative
Qualitative Benefits	**Qualitative Indicator**
Increased Water Supply Reliability	MCL Standards Met.++
Reduced Medical Health Costs	Lower Incidents of As And NO3 Related Conditions.+
Improved Disposal of Treatment Residue (Lost Hills)	Lower Disposal Costs.+

Notes:
+ indicates net benefits are likely to increase
++ indicates net benefits are likely to increase significantly
O&M = operations and maintenance

Benefits of Destruction of Problem Wells

Destruction of problem wells will reduce or eliminate transport of As, NO3 or other contaminants of concern into aquifer zones supplying water to DAC communities. The benefits of eliminating of problem wells include improvement of ground-water quality, leading to improvement of sources of DAC water supply and protection of public health. Direct benefits include reduced medical health costs. The benefits associated with developing DAC benefits are summarized in Tables 8.5-3 and 8.5-4.

EXHIBIT 8.5-3
Project 5 Destruction of Problem Wells Benefit Overview

Type of Benefit	Assessment	Beneficiaries
Water Supply Benefits		
Increased Water Supply Reliability	Qualitative	Local
Water Quality Benefits		
Improved Quality In Potable Supply	Qualitative	Local
Other Benefits		
Reduced Medical Health Costs		

EXHIBIT 8.5-4
Project 5 Destruction of Problem Wells Benefit and Cost Summary

Type of Benefits/Costs	Present Value
Capital and O&M Costs	$383,455
Quantitative Benefits	
Qualitative Benefits	**Qualitative Indicator**
Increased Water Supply Reliability	MCL Standards Met ++
Reduced Medical Health Costs	Lower Incidents of As And NO3 Related Conditions +

Notes:
+ indicates net benefits are likely to increase
++ indicates net benefits are likely to increase significantly
O&M = operations and maintenance

8.5.1.1 Improved Water Quality

Without the project DAC communities would continue to rely on water supply systems that deliver water that exceed or are approaching MCL levels to their customers. These communities would not have the resources to design and permit improvements to their systems that would address these problems. With the project DAC communities could develop engineering and permitting phases of system improvements that would allow funding through state and federal programs.

Without the Project, problem wells would continue to be an avenue for contaminants such as AS and O3 to travel from zones that exceed drinking water standards to zones developed for DAC water supplies. DAC communities would continue to rely on wells developing water that exceeds water quality standards or is worsening with time. With the Project, DAC residents would see a stabilizing and eventual improvement on their source water quality.

Arsenic and NO3 in water supplies have serious health effects. It is well documented that long-term exposure to arsenic can result in skin, lung and bladder cancer, as well as cardiovascular disease. Possible health effects from short-term exposure to nitrates in drinking water can result in methemoglobinemia or Blue Baby Syndrome. This has been described as a major environmental justice issue. Thus reducing sources of As and NO3 form DAC water sources will have direct benefits to DAC residents health, and will address an environmental justice issue. Although health benefits are only discussed qualitatively, these benefits are important from an environmental justice perspective and important to the community as a whole.

8.5.1.2 Other Benefits

Several other benefits can be attributed to the system upgrade studies. If these projects are implemented, property values in these communities would increase. In the case of the Lost Hills Utility District, the District would be able to better dispose of As laden waste from it water treatment system.

8.5.2 Distribution of Benefits and Identification of Beneficiaries

The improved quality of water supply will benefit the residents of each of the 5 DAC communities receiving founding for project development. The improvement of ground water quality due to destruction of problem wells would benefit residents of nearby communities. Improved health would benefit the residents of each DAC directly and the taxpayers of the County of Kern with lower support necessary to health care for the needy.

8.5.3 Benefits Timeline

The estimated life of the DAC project development studies is 2 years. The estimated life of the well destruction program is 2 years. The Project will begin in 2011, and benefits of well destruction will begin late in year 2011, because identification of problem wells and arranging for destruction work will take several months. The DAC project development studies are expected to be complete within two years (2013) and the benefits of the studies would begin once the projects are actually implemented. No estimate is provided of implementation, because future conditions that affect funding for projects cannot be predicted.

8.5.4 Uncertainties

There is uncertainty regarding the benefits of improved water quality. The levels and timing of improvement are uncertain. The level of current health costs due to poor water quality and potential health improvements are not known.

8.5.5 Potential Adverse Effects

The well destruction element of the Project will cause minor temporary disturbances that will be mitigated, and there are no long term impacts expected as a result of the Project. Any unforeseen temporary impacts will be mitigated.

8.5.6 Summary of Findings

Project benefits will occur from the improved water quality and avoided health costs. Because these benefits are only discussed qualitatively, monetized benefits claimed for this Project cannot be estimated, but may be significant in the long run due to improved health.

8.5.7 Appendices

There are no appendices for this Section.

8.5.8 Tables

There are no tables for this Section

8.6 Project 6 – Consolidation of Bishop Acres into City of Shafter Water Supply System

Project 6 will integrate the “standalone” water well and distribution system serving the unincorporated community of Bishop Acres with the water supply and distribution system of the City of Shafter so as to increase the level of service and reliability of 26 households in Bishop Acres. The City would modify its system to include the following:

- Approximately 800 linear feet of water distribution main (under 16-inch in diameter) to Bishop Acres
- Approximately 275 foot feet of boring casing and carrier pipe across BNSF rail mainline and County of Kern roadway
- New valves and control equipment at the interconnection
- Rehabilitation and automation of the existing Bishop Acres well

The benefits of interconnecting the Bishop Acres to the City’s service area include improved operability and reliability of delivery to the Bishop Acres and increased operational flexibility of the City system as a whole due to acquisition of an additional supply well. Direct benefits include reduced supply interruptions to the Bishop Acres area and opportunity to blend multiple sources to optimize water quality.

8.6.1 Costs

The Consolidation of Bishop Acres into City of Shafter Water Supply System Project has an estimated project cost of $444,500. The Poso Creek RWMG is requesting $444,500 in Prop 84 Implementation Grant funding. The requested grant funding will be applied toward consolidating Bishop Acres with the City of Shafter supply system.

8.6.2 Water Quality and Other Benefits

Indirect benefits include better management of the costs of delivering water to the City’s customer base and resulting control of delivery costs. Both Bishop Acres and the City of Shafter are classified as DACs. The benefits associated with Project are summarized in Exhibits 8.6-1 and 8.6-2.

EXHIBIT 8.6-1
Project 6 Benefit Overview

Type of Benefit	Assessment	Beneficiaries
Water Supply Benefits		
Increase Water Supply Reliability	Qualitative	Local
Other Benefits		
Reduced/Avoided Operating Costs	Qualitative	Local
Improved Quality of Water Delivered	Qualitative	Local

EXHIBIT 8.6-2
Project 6 Benefit and Cost Summary

Type of Benefits/Costs	Present Value
Capital and O&M Costs	**$384,493**
Qualitative Benefits	**Qualitative Indicator**
Reduced/Avoided Operating Costs	Reduced O&M due to limiting use of existing well$6,000/yr, Eliminating Third Party System Operation and Consolidating with City's Operation…$6,000/yr
Increase Water Supply Reliability.	Qualitative +
Improved Quality Of Water Delivered	Qualitative +

Notes:
+ indicates net benefits are likely to increase
++ indicates net benefits are likely to increase significantly
O&M = operations and maintenance

8.6.2.1 Reduced/Avoided Operating Costs

The Bishop Acres Mutual Water Company has to spend approximately $3,000 for every well service interruption in its service area and has no funds to properly maintain the well to minimize service disruptions. By connecting to the City's system, these interruptions could be avoided. In addition, integration with a larger system should bring some economies of scale in routine maintenance and other overhead costs. By integrating with the City system, Bishop Acres customers should avoid approximately $160,000 over the 20 year life of the project.

Cost to consolidate the Bishop Acres system with the City of Shafter without grant funds would be approximately $12,000 per household.

8.6.2.2 Improved Quality of Water Supplied to Customers City-wide

Without the Project, the residents Shafter and Bishop Acres would continue to rely on separate water supply sources with limited opportunities for management. With the Project, the system would rely on multiple wells that could be managed to blend water and optimize water quality.

8.6.3 Distribution of Benefits and Identification of Beneficiaries

Reduction in operating costs would benefit the residents of Bishop Acres. The improved service reliability would benefit residents of Bishop Acres. Improvements in water quality would benefit all residents within the City of Shafter.

8.6.4 Benefits Timeline

The estimated life of the Project is over the entire period of analysis, which is 20 years beginning in 2011. The Project will begin in 2011, and benefits will begin in full in year 2012, because integration would be complete in mid-2012.

8.6.5 Uncertainties

There is uncertainty regarding the benefits of improved system reliability. Current benefit descriptions are based on incomplete descriptions of water supply interruptions in the Bishop Acres service area.

8.6.6 Potential Adverse Effects

The Project will cause minor temporary disturbances due to pipeline installation that will be mitigated, and there are no long term adverse impacts expected as a result of the Project. Any unforeseen temporary impacts will be mitigated.

8.6.7 Summary of Findings

Project benefits due to interconnecting the Bishop Acres to the City's service area include improved operability and reliability of delivery to the Bishop Acres and increased operational flexibility of the City system as a whole. Direct benefits reduced supply interruptions to the Bishop Acres area and opportunity to blend multiple sources to optimize water quality. Indirect benefits include better management of the costs of delivering water to the City's customer base and resulting control of delivery costs. Monetized benefits claimed for this Project are likely on the low end.

8.6.8 Appendices

There are no appendices for this Section.

8.6.9 Tables

There are no tables for this Section

8.7 Project 7 – North Shafter Sewer Hook-up Reimbursement Fund

The City of Shafter is currently implementing a grant project to extend its wastewater collection system to the North Shafter community, which is not being funded as part of this Proposal. As part of this Proposal, Project 7 is to provide the mechanism and economic incentive for 240 DAC households to complete their individual property hook-ups to the new sewer collection system. All the households are on septic tanks and will remain on them until their house hook-up to the new sewer line is completed.

Most of the septic tanks are quite old with failing leach fields. Some households use deep seepage pits that drain the septic tank leachate closer to the groundwater. In 2005, 71% of the area's properties reported failing septic systems and/or use of greywater disposal into their lawns to avoid overloading of septic systems and reduce septic tank pumping. North Shafter residents report that many are forced to have their septic tanks pumped three or more times per year. The City of Shafter and Regional Water Quality Control Board have declared a potential pollution problem for the area based on local well contamination from failing septic systems.

8.7.1 Costs

The North Shafter Sewer Hook-Up Reimbursement Fund (Project7 or Project) has an estimated project cost of $540,100. The Poso Creek Regional Water Management Group (Poso RWMG) is requesting $480,000 in Prop 84 Implementation Grant Funding. The requested grant funding will be applied toward establishing a reimbursement fund, from which customers in the North Shafter area, a disadvantaged community, can be reimbursed for connecting to the City of Shafter's newly-constructed sewer collection system.

8.7.2 Water Quality and Other Benefits

The benefits of providing sewer service to North Shafter include elimination of sources of ground water pollution, protection of public health and increasing the amount of treated sewage effluent available for recharge. The City of Shafter secured funding assistance for the sewer upgrade facilities and is now constructing the new sewer collection system. Funding to ensure all 240 households complete their hook-ups to the new sewer collection system is not part of the present system upgrade funding. Therefore, the benefits of this Project 7 of this Proposal will ensure the benefits of the Sewer Improvement is realized by ensuring timely completion of individual house hook-ups in the DAC area where the population has little economic resources to pay for their sewer hook-ups.

Direct benefits of Project 7 include avoided costs of annual (or more frequent) septic tank pump-out, avoided costs of city spill response, increased property values, reduced medical health costs, and reduce risk for lawsuits, insurance claims, and legal fees. The benefits associated with Project are summarized in Exhibits 8.7-1 and 8.7-2.

EXHIBIT 8.7-1
Project 7 Benefit Overview

Type of Benefit	Assessment	Beneficiaries
Water Supply Benefits		
Increased Ground Water Supply	Monetized	Local
Water Quality Benefits		
Avoided Septic System Service	Monetized	Local
Avoided City Spill Response	Monetized	Local
Other Benefits		
Increased Property Values	Monetized	Local
Reduced Medical Health Costs	Monetized	Local
Improved Air Quality (Pump-out Trucks)	Qualitative	Local

EXHIBIT 8.7-2
Project 7 Benefit Cost Summary

Type of Benefits/Costs	Present Value
Capital And O&M Costs	$479,187
Quantitative Benefits	
Increased Groundwater Supply	$309,690
Avoided Septic System Service	$500,000
Increased Property Values	$2,400,000
Qualitative Benefits	**Qualitative Indicator**
Reduced Medical Health Costs	+
Improved Air Quality (Pump-out Trucks)	+

Notes:
+ indicates net benefits are likely to increase with Project
++ indicates net benefits are likely to increase significantly with Project
O&M = operations and maintenance

8.7.2.1 Improved Air Quality

Without the Project, the residents of North Shafter would continue to rely on regular pump-outs and other servicing of their septic systems. With the Project, these residents would avoid pump-outs and other servicing. A typical pump out consumes diesel fuel for pump-out and transportation. This results in emissions of NOx, ROx, CO and GHG. These emissions would be avoided with the project

8.7.2.2 Avoided Tank Servicing and Repairs

The affected residents will avoid approximately $500,000 over the 20 year life of the project by not having to service or repair failing septic tank systems.

8.7.2.3 Other Benefits

Several other benefits can be attributed to leak detection and repair programs. In addition to the benefits in Attachment 7 and the improved air quality, eliminating septic systems improves property values and reduces medical health costs from exposure to pathogens. If property values are assumed to rise 5% as a result of elimination of the ubiquitous septic system failures, the average value of homes would increase approximately $10,000. Approximately 240 homes are expected to be hooked up resulting in an increase of $2,400,000 in overall property values. Although health benefits are only discussed qualitatively, these benefits are important from an environmental justice perspective and important to the community as a whole.

8.7.3 Distribution of Benefits and Identification of Beneficiaries

The improved air quality will benefit the residents within the City of Shafter. The reduction in carbon dioxide emissions will also benefit the residents of California. Reduced carbon emissions is a goal of the State of California as reflected in *Assembly Bill 32, Global Warming Solutions Act of 2006*. Improved property values would benefit the residents of the North Shafter area directly. Improved health would benefit the residents of North Shafter directly and the taxpayers of the County of Kern with lower support necessary to health care for the needy.

8.7.4 Benefits Timeline

The estimated life of the Project is over the entire period of analysis, which is 20 years beginning in 2011. The Project will begin in 2011, and benefits will begin in full in year 2012, because sewer hookups will occur throughout the construction phase, connecting all serviceable properties that qualify for funding in 2012.

8.7.5 Uncertainties

There is uncertainty regarding the benefits of improved air quality. Current benefit descriptions are based on estimates of pump-out frequency. Property value increase is estimated on increased value seen in other areas in similar circumstance. Experience in other areas may or may not relate to what will occur in North Shafter.

8.7.6 Potential Adverse Effects

The Project will cause some minor and temporary disturbances that will be mitigated by the City and its representatives and but there will be no long term impacts expected as a result of the Project.

8.7.7 Summary of Findings

Project benefits will occur from the avoided cost of servicing septic systems, lower air emissions and improvement in public health. Property values are also very likely to cause a benefit to landowners of affected properties. Monetized benefits claimed for this Project are avoided costs of septic system servicing and increased property values.

8.7.8 Appendices

There are no appendices for this Section.

8.7.9 Tables

There are no tables for this Section

8.8 Project 8: Provide Water Meters in Severely Disadvantaged Community Service Areas

The City of Shafter has approximately 600 meters to retrofit and update to Shafter's current Automatic Meter Reading standard in the areas surrounding the City that have, in the past, connected their drinking water systems with the City. These connected areas include North Shafter, South Shafter and Southwest Shafter water improvement areas. Having these outside the City connections equipped with meters and radios to transmit consumption electronically will help the City avoid costs for retrofitting and labor for manual reads which would in turn force us to pass along the costs to severely disadvantaged communities.

8.8.1 Costs

The Meter Installation in DAC Service Area Project has an estimated project cost of $579,320. The requested grant funding will be applied toward the installation of water meters in the DAC service areas in the City of Shafter.

8.8.2 Water Quality and Other Benefits

The benefits of retrofitting and updating 600 meters to Shafter's current Automatic Meter Reading standard in the North Shafter, South Shafter and Southwest Shafter water improvement areas include better management of the City's water supply and avoided time and energy spent in reading the meters. Direct benefits include avoided costs of monthly meter reading and reduced vehicle emissions. Indirect costs include better management of the City's water supply system leading to prompt leak repair and other water conservation measures thereby preserving and protecting the health of the public that relies on the City's water supply. The benefits associated with Project are summarized in Exhibits 8.5.1 and 8.5-2.

EXHIBIT 8.8-1
Project 8 Benefit Overview

Type of Benefit	Assessment	Beneficiaries
Water Supply Benefits		
Increased Ground Water Supply	Qualitative	Local and Regional
Water Quality Benefits		
Other Benefits		
Reduced/avoided operating costs	Monetized	Local

Reduced meter installation costs	Monetized	Local
Improved Air Quality (Meter Reader Trucks)	Qualitative	Local and Regional
Improved leak detection and control	Quantitative	Local

EXHIBIT 8.8-2
Project 8 Benefit Cost Summary

Type of Benefits/Costs	Present Value
Capital and O&M Costs	$501,112
Quantitative Benefits	
Reduced/avoided operating costs	$36,000 per year for manual meter reads $349,639
Reduced meter installation costs	$800 per meter installation $480,000 – one time savings
Qualitative Benefits	**Qualitative Indicator**
Increased Groundwater Supply	Reduction of water unaccounted for in system
Improved Air Quality (Meter Reader Trucks)	+ (Reduction of Meter reader trucks)
Improved leak detection and control	++

Notes:
+ indicates net benefits are likely to increase with Project
++ indicates net benefits are likely to increase significantly with Project
O&M = operations and maintenance

8.8.2.1 Reduced/Avoided City Operating Costs

The approximate value of the City manually reading meters in the designated improvement areas is approximately $36,000 per year. By equipping radios with the meter assemblies, the City's utility customers in these severely disadvantaged areas will avoid approximately $540,000 over the 15-year life of the project.

Cost to purchase and install the meters would be approximately $800 per household. The project would avoid this cost being imposed on the 600 ratepayers in the target areas.

8.8.2.2 Improved Air Quality

Without the Project, the residents of North Shafter, South Shafter and Southwest Shafter would continue to rely on regular readings of meters by individuals using vehicles for transportation. With the Project, the meters would be read with telemetry and thus would require not on-site readings. The fuel savings and air quality benefits are not calculated and thus are reported as qualitative.

8.8.2.3 Other Benefits

Several other benefits can be attributed to installation of water meters. Meters allow leak detection and repair to avoid water loss and avoid unnecessary water charges. In addition water use information is the basis of effective public information in water conservation programs.

8.8.3 Distribution of Benefits and Identification of Beneficiaries

The improved air quality and lower operational costs will benefit the residents within the City of Shafter. The reduction in carbon dioxide emissions will also benefit the residents of California. Reduced carbon emissions is a goal of the State of California as reflected in *Assembly Bill 32, Global Warming Solutions Act of 2006*. Improved health would benefit the residents of North Shafter directly and the taxpayers of the County of Kern with lower support necessary to health care for the needy.

8.8.4 Benefits Timeline

The estimated life of the Project is over the entire period of analysis, which is 15 years beginning in 2011. The Project will begin in 2011, and benefits will begin in full in year 2012, because water meter installation would be complete in 2011.

8.8.5 Uncertainties

There is uncertainty regarding the benefits of improved air quality. Current benefit descriptions are based on effects of water meter information on customer behavior.

8.8.6 Potential Adverse Effects

The Project will cause minor temporary disturbances that will be mitigated, and there are no long term impacts expected as a result of the Project. Any unforeseen temporary impacts will be mitigated.

8.8.7 Summary of Findings

Project benefits will occur from the reduced emissions resulting from the reduction in energy requirements. Several other benefits can be attributed to installation of water meters, including lower operating costs, reduced water losses and improved public water conservation. Because improved air quality and other benefits are only discussed qualitatively, monetized benefits claimed for this Project are likely on the low end.

8.8.8 Appendices

There are no appendices for this Section.

8.8.9 Tables

There are no tables for this Section